Standardised measures in stroke rehabilitation and their application to stroke research.

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STANDARDISED MEASURES IN STROKE REHABILITATION AND THEIR APPLICATION TO STROKE RESEARCH

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SYNOPSIS

Non-comparability in patient selection and unreliability in data-collection are major methodological problems in stroke rehabilitation research. This thesis describes and evaluates methods of prognostic stratification and integrated multidisciplinary data-collection which are then used to assess the effectiveness of a stroke rehabilitation unit.

The Orpington Prognostic Score (OPS) was derived from a study of clinical determinants of stroke outcome in 96 elderly patients and incorporates measures of motor deficit, proprioception, balance and cognition. OPS correlated with Barthel index at discharge and was more predictive compared with either the Edinburgh Prognostic Score (r^2=0.89 v 0.57) or with the initial Barthel ADL index (r^2=0.89 v 0.24). Patients with OPS <3 were discharged early whereas those scoring >5 required long-term care. The predictive value of prognostic stratification using OPS was validated in a later study in 217 stroke survivors which confirmed previous observations. The score was also comparable to initial urinary incontinence for sensitivity (96% v 90%) and specificity (36% v 39%) but had a greater predictive value for institutionalisation (82% v 57%).

A 6 month evaluation of a ward-based, integrated, multidisciplinary computerised stroke assessments system showed a high level of acceptability. The increase in workload (15-60 minutes/week) was balanced by the benefits in patient care and research. A high degree of completeness (>90%) and accuracy (>95%) of data (1113 assessments on 67 patients) was seen.

These methods were used in a prospective study in which patients with comparable characteristics were randomly allocated to a stroke unit (n=124) or to general medical wards (n=121) and received comparable therapy input. A significantly better outcome was seen in patients with intermediate prognosis (OPS 3-5) managed on the stroke unit (discharge home: 75% v 52%, $p<0.001$; Barthel index at discharge: 15 v 13, $p<0.05$; mean hospital stay: 48.7±17.2 v 104.6±28.6 days, $p<0.001$) . This difference in

outcome was not seen in the "good" or the "poor" prognostic groups. The rate of functional recovery was faster and there appeared to be a mechanism of expediting discharges on the stroke unit. Younger patients on the stroke unit (n=53) showed better outcome when compared with those on general wards (n=48) on a range of measures (discharge home 83% v 60%; median Barthel index 17 v 13; median length of hospital stay 27 v 56 days). This difference was not seen in older patients (stroke unit, n=71; general wards, n=73), except for shorter hospital stay on the stroke unit (36 v 84 days). This may reflect better organisation of multidisciplinary care on geriatric wards.

These findings demonstrate the value and importance of the standardisation of measurement in stroke rehabilitation research, particularly in the conduct of controlled intervention studies and also in needs assessment, audit and planning of services.

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Corrigendum:

The word "motricity" has been misspelt as "motoricity" on page 47 and on other pages in which references have been made to the Motricity Index.

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CHAPTER 1. INTRODUCTION AND REVIEW OF LITERATURE

1.1 INTRODUCTION

1.1.1 Epidemiology of stroke

Stroke is recognised as a major health problem and a leading cause of death and disability in the adult population (Consensus Conference,1988; WHO,1971,1989; Royal College of Physicians,1989). Although several studies suggest that stroke-associated mortality has declined in the Western world since the mid-sixties (Baum & Goldstein,1982; Garraway,1983a,1985; Charlton & Velez,1986; Royal College of Physicians,1989; Klag, Welton & Seidler,1989; Ebrahim,1990), it still accounts for 10-15% of all deaths in Britain, especially in elderly people (Oxfordshire Community Stroke Project,1983; Gardner, Winter & Barker,1984; Office of Population Censuses & Surveys,1986; Royal College of Physicians,1989).

Despite the decrease in mortality, stroke prevalence has remained unchanged over the past several decades (Sorenson, Boysen, Jensen et al.,1982; Kurtzke,1982; Garraway,1983a,b; Bamford, Sandercock, Dennis & Warlow,1988). As only a third of stroke survivors will make a good recovery (Royal College of Physicians,1989; Bamford, Sandercock, Dennis & Warlow,1990), it is a major cause of chronic disability in older individuals. Stroke is estimated to be responsible for 14%-25% of severe disability in the community (Harris,1971; Gresham, Phillips, Wolf et al.,1979; Taub, Wolfe, Richardson et al.,1994) and has significant long-term resource implications for health and social services (Royal College of Physicians,1989).

1.1.2 The cost of stroke

The cost of stroke is high and accounts for approximately 3.9 to 4.6% of the total National Health Service expenditure (Carstairs,1976; OHE,1988). It is the single most expensive disorder managed in general hospitals (Carstairs,1976) and is estimated to cost £3 million annually (1986 costs) in an average district in England and Wales (Consensus Conference,1988). Stroke patients occupy nearly 21% of general medical beds (Wade, Wood & Langton-Hewer,1985) accounting for 10% of the district day-bed costs (Langton-Hewer,1990). Furthermore, poor coordination between hospital and community services results in about 40% of all hospital resources for stroke being used by 5-10% of patients who need major long-term support in homes or in the community rather than hospital care (Wade, Wood & Langton-Hewer,1985).

1.1.3 The future

The hospital burden of stroke is likely to escalate significantly in future because of the "ageing" of population (World Health Organisation,1984; Brommels, Tilvis & Autio,1987; OHE,1988). The projections of declining incidence of stroke (Garraway, Whisnant & Drury,1983a; Broderick,1993) are not universally accepted (Wolfe & Burney,1992) and it is envisaged that demographic changes will result in either no change or even an increase in first-ever strokes in England and Wales by the year 2023 (Malmgren, Bamford, Warlow et al.,1989; Wolfe & Burney,1992). Most of these strokes will occur in elderly people because of an age-related increase in incidence (Oxfordshire Community Stroke Project,1983; Bamford, Sandercock, Dennis & Warlow,1988). Elderly people are more likely to be hospitalised because of higher levels of frailty, co-morbidity, additional disabilities and social isolation (Wade & Langton-Hewer,1985a; Bamford, Sandercock, Warlow & Gray,1986). As fatality will be high in this group of patients, there will be only modest increases in the number of severely disabled people in the community (Malmgren, Bamford, Warlow et al.,1989).

It appears that increased burden of health care of stroke patients will primarily be that of caring for those in acute stages of stroke and not that of management of chronic disability in the community. This is is likely to push hospital costs of stroke management even higher than at present and has resulted in an urgent emphasis on developing cost-effective strategies of stroke management in hospitals based on standardised assessments and organised therapy input (Royal College of Physicians,1989).

1.2 REDUCING THE BURDEN OF STROKE

There is no single measure which, in itself, can overcome the burden of stroke either to the health services or to society. A pragmatic strategy would involve intervention at several levels (Table 1.1) ranging from prevention of stroke to alleviation of handicap in community settings (WHO,1971,1988; Consensus Conference,1988; Wade,1992a,1993b).

1.2.1 Stroke Prevention

The role of aggressive strategies aimed at stroke prevention cannot be overestimated. It is generally accepted that no intervention would have a greater impact on quality of life in old age than prevention of stroke (WHO,1971). Several unequivocal studies have shown that measures such as adequate control of hypertension (MRC,1985; Amery, Brixo, Clement et al.,1985,1986; MacMahon, Peto, Cutler et al.,1990; Collins, Peto, MacMahon et al.,1990), antiplatelet drugs (eg. aspirin) in patients with atherosclerosis (Antiplatelet Trialists Collaborative Group,1988;1994) and the use of anticoagulants in patients with atrial fibrillation (Stroke Prevention in Atrial Fibrillation Study Group,1990,1991; Albers, Sherman, Gress et al.,1991; European Atrial Fibrillation Trial,1993) significantly reduce the risk of stroke in the trial setting.

Table 1.1 Reducing the burden of stroke.

Prevention (Primary and Secondary):

Modification of risk factors: e.g. hypertension, smoking, lifestyle

Medical treatment: antiplatelets, anticoagulants

Surgical treatment: carotid endarterectomy

Effective Therapy:

Prevention and early treatment of acute complications

Medical to minimise impairment

Rehabilitation to minimise disability

Adaptations to minimise handicap

Better Support:

Patient and family - Counselling, education, training

Health services - community nursing, domiciliary rehabilitation

Statutory services - personal care, respite care

Voluntary agencies - clubs, information, day centres

Management of risk factors in the community including lifestyle changes are important aspects of stroke prevention and have been discussed at length elsewhere (Rose,1981; Rose & Day,1990; Ebrahim,1990; OXCHECK Study Group, 1991). To summarise, there is evidence that lifestyle changes such as cessation of smoking (Bonita, Scragg, Stewart et al.,1986; Colditz, Bonita, Stampfer et al.,1988; Wolf, D'Agostino, Kannel et al., 1988; Shinton & Beevers,1989; Donnan, McNeil, Adena et al.,1989; Shaper, Phillips, Pocock et al.,1991), lower cholesterol intake (Kannel & Gordon,1974; Shaper, Phillips, Pocock et al.,1991; Dennis & Warlow,1991; Warlow,1992) and exercise (Shinton & Sagar,1993) may reduce the risk of stroke. The success of any preventive programme implemented in the community, however, will depend upon adequate resorces, targeting (individual risk approach), acceptance rates and the ability to provide effective continued intervention and follow up (OXCHECK Study Group,1991;1994; Cutler, Grandits, Grimm et al.,1991).

The increasing availability and proven efficacy of carotid endarterectomies in prevention of stroke has been another important development (European Carotid Surgery Trialists' Collaborative Group,1991; North American Symptomatic Carotid Endarterectomy Trial,1991; Brown & Humphrey,1992). Although carotid endarterectomy may prevent strokes in individual patients, the procedure is unlikely to have any major impact as a stroke prevention strategy in the community (Hankey,1992).

The overwhelming evidence in favour of active intervention in stroke prevention has resulted in a government backed nation-wide drive to reduce the incidence of stroke (Health of the Nation,1991).

1.2.2 Effective Acute Management

Once a stroke has occurred, the predominant aim of management is to restore function. This can be achieved by medical or surgical means aimed at reducing

the size of the infarct and, thereby, the severity of impairment or by rehabilitation aimed at minimising disability secondary to this impairment (Table 1.1).

General treatment of all stroke patients comprises supportive and symptomatic measures which should be available to all stroke patients, especially if admitted to hospitals. These include maintenance of stable respiratory and cardiovascular function with particular attention to oxygenation and appropriate blood pressure, correction of fluid electrolyte imbalance and monitoring blood glucose levels, ensuring adequate nutrition, preventing hypo/hyperthermia as well as complications such as aspiration pneumonitis, urinary retention or infection, venous thromboembolism, seizures, pressure sores, contractures or dislocated/frozen shoulder. Despite the lack of direct evidence from controlled prospective studies, it is likely that interactive general management of stroke patients in the acute phase will result in lower mortality (Langhorne, Williams, Gilchrist, Howie,1993) and morbidity (Wade,1993b).

The role of specific medical or surgical interventions (except for surgery for hydrocephalus associated with cerebellar haemorrhage) remains controversial (Wade,1993b). Several studies involving a large number of therapeutic agents have been undertaken in the past with equivocal results (Hankey,1992; Wade 1992a). The current accepted view is that there is little that medical treatment and nothing that vascular surgery can do to alter the immediate outcome after cerebral infarction (Sandercock,1987; Rothrock & Hart,1991; Hankey,1992). This view may be set to change in the near future. Preliminary studies with thrombolytics (Levine & Brott,1992) and N-methyl-D-aspartame (NMDA) receptor antagonists (Scatton, Carter, Benavides et al.,1991) have shown encouraging results and definitive multicentre studies are currently in progress. The availability of potentially effective treatments for acute stroke will revolutionise clinical practice and have a significant impact on stroke management strategies.

It will be some time before these advances will result in changes in mainstream clinical practice. Until such time, early and planned multidisciplinary rehabilitation remains the cornerstone of stroke management, especially in patients

admitted to hospitals where such intervention may lead to shorter hospital stays and better functional outcome (Ebrahim,1990; Wade,1992a,d;1993a,b). Effective management of stroke also requires true integration of services across areas of interest (e.g. medical, rehabilitation and social services) to ensure mechanisms for timely mobilisation of appropriate resources and over time to achieve a seamless service from the onset of stroke to long-term care (Wade,1992b).

1.3 REHABILITATION IN STROKE

Rehabilitation in stroke is not simply being treated by a therapist or a group of therapists but involves the whole spectrum of management of disability tailored to restore patients to their fullest possible physical, mental and social capability (Langton-Hewer,1990; Wade 1993a).

1.3.1 Principles of Rehabilitation

The basic principles that should be applied throughout rehabilitation of stroke patients are:

1) Documenting impairments, disabilities and handicaps and, where possible, measuring them using simple, valid scales.

2) Maximising independence and minimising learned dependency.

3) Taking account of the whole person and the environment.

(Consensus Conference,1988)

1.3.2 Objectives of Rehabilitation

The goals of rehabilitation are not always easy to define because it deals with the whole spectrum of human performance. In general, rehabilitation should aim to

maximise patients' role fulfilment and independence in their environment within the limitations imposed by underlying impairments and availability of resources (Wade,1992d). It should help them to make the best adaptation possible to any differences between the roles desired and the roles achieved following stroke. Another important objective of the rehabilitation process is to monitor regularly the services provided to ensure that the best possible value is being obtained from the money and effort being expended (Langton-Hewer,1990).

1.3.3 Process of Rehabilitation

The process of rehabilitation has been described as a problem-solving educational process focusing on disability and aiming to reduce handicap (Wade,1992d). Its components are:

1) **Assessment:** which include measurement of deficits, identification of problems and analysis of underlying causes.

2) **Planning:** which is the process of goal setting based on identification of aims, objectives and targets.

3) **Intervention:** which has two further components:

a) care necessary to maintain status quo, and,

b) therapy to improve recovery.

4) **Evaluation:** which includes monitoring of patients' progress (or lack of it) and frequent assessments of the rehabilitation process itself.

1.3.3.1 Assessment

Prior to commencement of a rehabilitation programme, it is necessary to ascertain the precise nature and severity of deficits. The use of assessments enables problems to be identified and quantified so that patients' progress can be monitored to provide a logical basis for treatment and management (Langton-Hewer,1990).

The major aims of assessment are to identify the main areas of difficulty and their underlying causes, prognostic factors indicative of successful outcome and, most importantly, the aims of the patient and the family (Wade,1992d). Assessment is best carried out using standardised simple measures which are well-validated, reliable and sensitive enough to detect significant changes. As rehabilitation deals with the ill-defined concept of human performance, a considerable number of areas for potential assessment exist and a large number of techniques have been used. It may be more pragmatic and productive to select a small group of scales relevant to the objectives of intervention than to use comprehensive assessments to evaluate the overall outcome of rehabilitation (Keith,1990). There is considerable controversy about "assessment tools" relevant to stroke practice and this aspect of stroke rehabilitation has been discussed at length in a later section (Section 1.6).

1.3.3.2 Planning

Many difficulties in stroke rehabilitation arise because the goals of intervention are not set in advance or because these have not been discussed and agreed upon by all relevant parties (Wade,1992d). The two major problems in goal-setting include failure to use a "common language" between various professionals, or between professionals and patients and, secondly, to agree upon a timeframe during which the rehabilitation process needs to be accomplished (Davis, Davis, Moss et al.,1992). There is often a discrepancy between the goals of the patient and their families and those of professional staff. An essential function of the whole rehabilitation team is to identify and modify unrealistic expectations of the patient and their family by making them more aware of the nature of residual deficit and expected prognosis as soon as these are reasonably clear (Wade,1992d). The areas of practical importance in goal setting are:

1) Accommodation: where will the patient live and what physical adaptations will be needed?

2) Personal support: what help will be essential for the patient?

3) Life satisfaction: what roles will the patient be fulfilling within his/her social setting and how will they be occupying their time?

1.3.3.3 Therapy Intervention

The objectives of therapy intervention are two-fold, firstly to prevent deterioration and maintain status quo and secondly to improve outcome by minimising disability and reducing handicap. Traditional therapy input lacks a proper physiological basis because little is known about the processes underlying the return of neurological function (Wade,1993a). A recent study using positron emission tomography suggests that "new" cerebral areas, usually in the frontal cortex and not used in normal persons, are activated during the recovery process (Weiller, Chollet & Friston et al.,1992). In addition, activation of the unaffected side is altered suggesting considerable changes in brain activity following stroke. These preliminary observations need wider confirmation and further research is required in conjunction with therapy disciplines to provide a scientific basis for rehabilitation in stroke.

Specific therapy interventions

Literature on therapy intervention in stroke is scant and consists largely of poorly-designed studies undertaken in small groups of patients (Langton-Hewer,1990; Wade,1992a). An overview of these studies suggests:

1) It is virtually impossible to design trials comparing therapy with no therapy despite no proof of effectiveness because of ethical considerations (Langton-Hewer,1990).

2) There are few trials which compare different therapeutic techniques and none has shown conclusively that one technique is superior to any other in the major areas of physical therapy (Feldman, Lee, Unterecker et al.,1962; Stern, McDowell, Miller & Robinson,1970; Inaba, Edberg, Montgomery & Gillis,1973; Logigian, Samuels, Falconer & Zagar,1983; Dickstein, Hocherman, Pillar & Shaham,1986; Lord & Hall,1986;

Edmans & Lincoln,1991) or in speech and language function (David, Enderby & Bainton,1982; Howard, Patterson, Franklin et al.,1985; Lincoln, Pickersgill, Hankey & Hilton,1982; Lincoln & Pickersgill,1984; Lincoln, McGuirk, Mulley et al.,1984). Randomised studies on social services intervention (Towle, Lincoln & Mayfield,1989) and on counselling and education to carers (Lincoln, Jones & Mulley,1985; Evans, Matlock & Bishop,1988) have also failed to show any significant differences between the study and control groups.

3) There appears to be a direct relationship between severity of stroke and the amount of therapy actually given. More severely disabled patients tend to receive more therapy (Brocklehurst, Andrews, Richards & Laycock,1978; Wade, Skilbeck, Langton-Hewer & Wood,1984) and there are concerns that intensive treatment is being offered to patients who are unlikely to benefit from such input (Brocklehurst, Andrews, Richards & Laycock,1978).

Duration and Intensity of therapy

The amount of formal therapy received by stroke patients is small and averages 46 minutes each working day (Wade, Skilbeck, Langton-Hewer & Wood,1984) or 3-4% of a patient's time awake in each week, even in specialist centres (Tinson,1989). The effects of intensive outpatient therapy (4 days a week), conventional therapy (3 half-days a week) and no therapy in stroke patients were investigated in a randomised, controlled trial (Smith, Goldenberg & Ashburn,1981). The results showed a small but definite relationship between the amount of therapy given and the amount of improvement in ADL function. Patients who received no therapy deteriorated significantly compared with the other two groups. In a more recent study complying with rigorous trial standards, patients with incomplete arm paralysis were shown to benefit by an enhanced level (twice the usual level) of therapy input (Sunderland, Tinson, Bradley et al.,1992). This improvement was due to improvement in general arm-function rather than changes in attention or adaptive mechanisms. There now is increasing evidence that

early and intensive therapy has a beneficial effect on the speed of early recovery, although its long-term benefits remain equivocal (Garraway, Akhtar, Prescott & Hockey,1980; Garraway, Akhtar, Hockey & Prescott,1980; Smith, Garraway, Smith & Akhtar,1982; Hamrin,1982a,b; Sivenius, Pyorala, Heinonen et al.,1985; Indredavik,Bakke, Solberg et al.,1992).

1.3.4 Problems in assessing the effectiveness of rehabilitation

The objective assessment of the effectiveness of rehabilitation in stroke has proved difficult for several reasons. Major factors which contribute to this problem are spontaneous recovery from stroke, difficulty in defining the extent of need, perceptions of "good" outcome and the methodology of studies undertaken in the past.

Spontaneous recovery from stroke

The majority of patients who survive stroke will exhibit degrees of spontaneous recovery either due to return of neural control mechanisms or because of adaptive mechanisms which involve the use of alternative strategies. The few detailed studies on the recovery process (Marquardsen,1969; Andrews, Brocklehurst, Richards & Laycock,1981; Skilbeck, Wade, Langton-Hewer & Wood,1983) have shown that recovery is fastest during the first three months, the very period during which patients are likely to receive maximum rehabilitation input. This makes it difficult to disentangle the effects of rehabilitation from spontaneous recovery and is reflected by the high level of controversy in the literature (Wade,1992a).

Difficulty in defining the extent of need

The extent of need is also difficult to define. Although most patients will have some disabilities and problems relating to the stroke, it is unlikely that the level of

disability will always relate to the scale of problems encountered by stroke patients. A severely disabled person who needs nursing home care has few rehabilitation requirements and does not pose a serious management problem. The rehabilitation needs of a moderately disabled person who chooses to live alone in inappropriate accommodation, on the other hand, are great and require an inordinately high level of resource input.

Perceptions of "good" outcome

The aims of rehabilitation vary according to the expectations of involved parties (Wade,1993a). The aim for hospitals may be to discharge patients as soon as possible whereas the aim for the patient may be to return to previous functional status, even if this is unattainable. The aim for carers may be to minimise the level of input they need to provide, even at the cost of institutionalisation. Many of the difficulties ultimately faced in the management of patients can be traced back to conflicts between the aims and objectives of different parties (Wade,1992d). Differences in expectations and perceptions of "good" outcome have resulted in considerable variability in the results of stroke rehabilitation studies depending upon the point of view of the investigator.

Methodology of rehabilitation studies

Several methodological problems are encountered when evaluating specific rehabilitation techniques. These include:

1) Difficulty in separating out the effects of therapy interventions from those of medical, nursing and social input.

2) Ethical constraints in designing controlled trials in which a patient group may receive no therapy input.

3) Variability in patient samples, rehabilitation settings and duration and type of therapy

received by patients.

4) Inadequate sample sizes, poor study-designs and inappropriate outcome measures (Wade,1992a).

5) Lack of a scientific basis for some of the interventions undertaken (Lind,1982).

1.3.5 Conclusions on rehabilitation

The review of literature on rehabilitation suggests that:

1) Well-organised and planned rehabilitation which is guided by well-defined goals based on adequate assessments and negotiations with patients/carers reduces disability and long-term institutionalisation.

2) There is no evidence to support any specific treatment technique. A pragmatic, functional approach is recommended and adherence to unscientific theories (eg. Bobath) is discouraged (Wade,1992d).

3) Early and intensive intervention by therapists may speed recovery and hasten discharge from hospital without increasing the total amount of therapy input.

1.4 ORGANISATION OF REHABILITATION

In the course of their illness, stroke patients will interact with many professionals who often work for different agencies (Wade,1993a). The scope for well-meaning but uncoordinated action is very great and has been recognised in the review on the state of stroke services in Britain (Consensus Conference,1988). The major problems identified include:

1) Misunderstanding and rivalries between professionals.

2) Breakdown of communication between professionals, patients and their carers.

3) Insufficient appreciation of the impact of stroke on patients' families.

4) Ill-prepared and sometimes unplanned discharges.

5) Serious shortage of therapy.

6) Long periods during which patients are unoccupied.

7) Ill-considered admission to hospital.

8) Failure to recognise and respond to mood disturbances.

9) Delegation of care to inadequately trained medical staff.

10) Confusion caused by too many people being involved.

These criticisms suggest that organising stroke care may be advantageous for patients and health services (Reding & McDowell,1989; Ottenbacher & Jannell,1993; Wade,1993a,b). Despite the obvious advantages of organisation of services, there has been little progress until recently because of the fear that changes in pre-existing services may incur large costs but bring only small benefits. The changes occurring in the British health system are forcing service providers to consider the setting and monitoring of standards in patient care, which has been responsible for altering present hospital centred systems towards more problem and service oriented systems. These pressures have resulted in a "fresh look" at the provision of stroke services and several models of care are currently in use or being developed (Langton-Hewer,1990; Wade,1992a; Russell, Hamilton & Tweedie,1993). Current strategies include stroke care areas on general medical wards (Wade, Wood & Langton-Hewer,1985; Stephen & Lightbody,1991), stroke units (acute and rehabilitation), hospital stroke teams (Wood-Daupinee, Shapiro, Bass et al.,1984; Stone,1987) and stroke teams in the community (Young & Forster,1991;1992; Gladman, Lincoln & Barer,1993; Gladman & Lincoln,1994). Of these strategies, only stroke units or specialist stroke areas will be discussed in subsequent sections.

1.5 STROKE UNITS

The concept of specialist stroke units to provide care for stroke patients was first proposed over 20 years ago (WHO,1971; Rehabilitation Study Group,1972). Despite this, there continues to be considerable debate about their definition and composition (Bonner,1973; McCann & Culbertson,1976; Issacs 1977; Feigenson & McCarthy,1977; US Dept. of Health,1976; Garraway,1985; Wade,1992a; Langhorne, Williams, Gilchrist & Howie,1993) as well as their role in managing stroke patients (Garraway,1985; Reding & McDowell,1989; Dobkin,1989; Langton-Hewer,1990; Ottenbacher & Jannell,1993; Wade,1993a; Langhorne, Williams, Gilchrist & Howie,1993).

The definition of a stroke unit relevant to the investigations undertaken in this thesis is "a geographic location within the hospital designated for stroke and stroke-like patients who are in need of rehabilitation services and the skilled professional care that such an unit can provide" (McCann & Culbertson,1976). The characteristic features of these units include:

1) Identification and awareness of the objectives of rehabilitation.

2) Development and implementation of a collaborative multidisciplinary policy for stroke management.

3) Comprehensive assessment of all aspects of patients' illness and disability.

4) Development of an educational role.

(Isaacs,1977; Garraway,1985; Ebrahim 1990)

Although many different disciplines have been suggested for inclusion in stroke rehabilitation teams (Garraway,1985), the core professionals are a physician, nursing staff, physiotherapists, occupational therapists, speech therapists and medical social workers all of whom have important contributions to make to stroke rehabilitation (US Dept of Health,1976; Isaacs,1977). Co-ordinated action is required to formulate and provide an integrated rehabilitation plan suited to the individual problems and disabilities

of each patient. This involves regular team meetings and multidisciplinary ward rounds with each member participating in all activities of the stroke unit (Isaacs,1977).

Two different forms of stroke unit care have been described:

1) "intensive care" units, which enjoyed brief popularity in the early seventies and may again be relevant, keeping in view recent developments in acute management.

2) Non-intensive (rehabilitation) units incorporating an integrated multidisciplinary programme of either acute management with rehabilitation or rehabilitation services alone.
(Garraway,1985; Wade,1992a)

1.5.1 Acute (intensive care) stroke units

The possibility of altering the course of stroke by aggressive intervention in the acute phase has lead to proposals of stroke intensive care units modelled on the lines of coronary care units. Although several reports have described some form of evaluation of acute stroke units (Kennedy, Pozen & Gabelman,1970; Carpenter & Reed,1972; Cooper, Olivet & Woolsey,1972; Drake, Hamilton, Carlsson & Blumenkrantz,1973; Pitner & Mance,1973; Norris & Hachinski,1976; Erila & Ilmavirta,1990; Hommel, Memin, Besson & Perret,1991; Morris, Grosset, Squire et al.,1993), there are only 5 controlled studies reported in the literature (Kennedy, Pozen & Gabelman,1970; Drake, Hamilton, Carlsson & Blumenkrantz,1973; Pitner & Mance,1973; Norris & Hachinski,1976; Erila & Ilmavirta,1990). Formal randomisation of a small number of stroke patients has been undertaken in only one of these studies (Erila & Ilmavirta,1990).

A prospective study on stroke patients managed on a stroke intensive care unit and two community hospitals showed no difference in acute mortality between the three settings (Kennedy, Pozen & Gabelman,1970). In a study involving 6 hospitals, Drake et al. (1973) compared patients in three neurovascular care units with matched stroke patients on general wards in three other district hospitals. Patients managed on the neurovascular units showed improved mortality and fewer complications compared with general wards. However, there was considerable variability within and between hospitals. Hospitals which had shown low mortality and complication rates on neurovascular units already had a low complication rate prior to the establishment of these units. This suggests that the observed differences were due to practices already prevalent in these hospitals rather than due to the establishment of specialist units. In another study, mortality was comparable between 81 stroke patients managed on a stroke intensive care unit and matched controls managed on general neurological wards (Pitner & Mance,1973).

Recent years have seen a resurgence of interest in acute stroke units for patient management and stroke research. The potential benefits of these units include:

1) the opportunity for early treatment with thrombolytic, neuroprotective or anticoagulant drugs.

2) the opportunity for randomised trials of acute treatments (pharmacological & non-pharmacological) and of novel investigations in stroke.

3) improved coordination within the stroke team.

(Lees,1992; Russell, Hamilton & Tweedie,1993)

There is considerable geographical variation in the organisation of these units depending upon perceived needs and the availability of resources. The "core" working practices of most acute units include direct admission of stroke patients as early as possible after acute onset, comprehensive investigations including universal CT scanning at the time of admission and intensive medical, nursing and therapy input (Lees,1992; Hinkle,1992; Russell, Hamilton & Tweedie,1993).

There are no adequate randomised controlled studies on modern acute stroke units reported in the literature and their effectiveness in reducing mortality or morbidity remains unknown. Acute stroke units will, undoubtedly, facilitate acute thrombolytic or neuroprotective intervention in individual patients but their overall contribution in reducing the burden of stroke remains open to question. Approximately 15% of the strokes are haemorrhagic and not suitable for thrombolytic interventions. Of the remainder, up to 50% of patients present too late for any acute intervention and about 25% of patients have strokes during sleep when the time of onset cannot be determined (Harper, Haigh, Potter & Castleden,1992). In a recently published evaluation of 200 patients admitted to the Glasgow unit, although 70% of the patients had presented within 12 hours of stroke, only 9 (4.5%) were eligible for any kind of acute thrombolytic intervention (Morris, Grosset, Squire et al.,1993). This was confirmed in a more recent study undertaken to ascertain the number of patients meeting the eligibility criteria commonly applied for pharmacological intervention in acute ischaemic stroke (Panayiotou, Fotherby, Potter & Castleden,1994). The study showed that 94% of the 410 stroke patients presenting to a district general hospital would be ineligible for any pharmacological treatment, if available, according to current criteria for intervention.

The mean duration of stay on acute stroke units is estimated at approximately 72 hours (Lees,1992), which may be not be long enough for a significant proportion of stroke patients to stabilise so that their therapy needs can be assessed. A recent study has shown that the conversion of an 8-bed acute stroke care unit offering intensive early management to an 8-bed stroke rehabilitation unit resulted in better outcomes (Parfenchuck, Parziale, Liberman et al.,1990). A higher percentage of patients were discharged home with fewer patients requiring institutionalisation. Although the length of hospital stay was increased, the overall costs to the hospital were reduced due to more efficient use of beds.

Some studies suggests that management on an acute stroke unit may lead to a lower rate of post-stroke complications (Kennedy, Pozen, Gabelman et al.,1970; Drake, Hamilton, Carlsson et al.,1973) but this has not been confirmed in other

controlled studies. Acute stroke units may have a limited role in reducing immediate post-stroke mortality, probably because most of the early mortality is due to irreversible neurological damage rather than due to preventable causes. The reduction in mortality reported by Langhorne et al. (1993) appears to be generic to stroke unit management rather than being limited to acute stroke units. The studies included in the meta-analysis support the conclusion that stroke units which managed the whole stroke episode rather than the first few days of an illness were more effective in preventing mortality, possibly because of greater awareness and early management of complications which develop over time in stroke patients (Dromerick & Reding,1994).

Acute stroke units require relatively high multidisciplinary staffing and equipment levels which makes them considerably more expensive than average units with similar bed complements (Lees,1992; Hinkle,1992; Russell, Hamilton & Tweedie,1993). The cost-effectiveness of such units needs to be proven before they can be recommended in mainstream clinical practice.

The value of acute stroke units in stroke research should not be underestimated. The "window" for acute intervention to limit the extent of neurological deficit is narrow and requires urgent investigations and interventions for any treatment to be successful. There are several overviews of the problems encountered in acute stroke research (Barer, Main & Lodwick,1992; Hankey,1992; Wade,1992a; Panayiotou, Fotherby, Potter & Castleden,1994). These problems can only be overcome by the high level of organisation represented in acute stroke units (Morris, Grosset, Squire et al.,1993). The difficulties posed by the small numbers of suitable patients who can be recruited for acute studies, even on such units, highlight the need for several similar, adequately resourced, units to conduct definitive studies on acute stroke management which have the potential to significantly alter clinical practice (Morris, Grosset, Squire et al.,1993).

To summarise, there is little scientific evidence so far to suggest that stroke intensive care units have any impact on reducing mortality or complications during the immediate period following stroke onset (Millikan,1979; Garraway,1985;

Wade,1992a). The benefits of such units at present may be limited to research. Meanwhile, the emphasis of stroke management needs to be on improving outcome in stroke survivors, principally by reducing disability and handicap. The role of rehabilitation and of non-acute stroke (rehabilitation) units is central to this issue.

1.5.2 Non-intensive (rehabilitation) stroke units

Several studies have been undertaken to evaluate the role of non-intensive stroke units in the management of stroke patients. A significant proportion of initial studies were either non-randomised or poorly randomised but recent years have seen several formally randomised studies comparing stroke management in specialist stroke areas with general medical wards (Table 1.2).

1.5.2.1 Non-randomised studies

In an early study of stroke unit rehabilitation (Adams,1974), outcome in elderly stroke patients in the years preceding the establishment of a stroke unit (1948-1956) was compared with outcome following its establishment (1956-1958). The study showed that there was a significant decrease in early mortality (<2 months) and a decrease in the need for long-stay care. The number of patients achieving sufficient functional independence to be discharged home rose from 40% to 60%. However, neither the comparability of patient selection criteria and treatment methods nor the standardisation of functional measures over a long period of observation was described in the study. In another study, the proportion of stroke patients returning home rose from 13% to 58% following the establishment of a stroke unit in one hospital (Dow, Dick & Crowell,1974). A comparable change was not seen in control patients of equivalent

stroke severity who were managed in other hospitals without a similar unit. No attempts were made at matching variables (other than the severity of deficit) between the study and the control group and outcome measures did not include assessment of functional status.

A significantly better outcome was seen in 224 patients managed on a stroke rehabilitation unit compared with 110 patients approved for stroke unit care but managed on general wards because of non-availability of beds on the specialist unit (McCann & Culbertson,1976). Patients with moderate functional disabilities at the time of admission benefited significantly from stroke unit rehabilitation, whereas no significant differences were seen in patients with mild or severe disability. Practices differed significantly between the two settings and the stroke unit was characterised by aggressive "specialised" nursing and therapy policies with a high level of family involvement. Similar results were seen by Feigensen and his colleagues (1979) in 589 stroke patients managed on a stroke unit compared with 78 stroke patients managed in mixed disability rehabilitation wards scattered around the hospital. Both groups received similar treatment programmes which were provided by staff who had rotated through the stroke unit. The inequality in numbers between the two groups makes it difficult for any conclusions to be drawn from this study.

Several other studies have described experiences of stroke rehabilitation units (Isaacs & Marks,1973; Blower & Shaukat,1979; Von Arbin, Britton, de Faire et al.,1980; Orgogozo, Castel, Dartigues et al.,1982; Langton-Hewer & Holbrook,1983). Although limited in their impact, the results of these studies were interesting enough to encourage further and more methodical investigation into the benefits of stroke unit rehabilitation.

Table 1.2 Summary of trials undertaken to evaluate the benefits of stroke unit rehabilitation.

REFERENCE	STUDY DESIGN					OUTCOME					
						SRU			GMW		
	Rand	SRU n	GMW n	Entry Time	Setting	Mort	Inst	LOS	Mort	Inst	LOS
Feldman et al,1962	FR	42	40	<2wks	Stroke Area	0	5	-	0	17	-
Peacock et al,1972	FR	29	23	<2wks	Stroke Area	0	-	-	1	-	-
Garraway et al,1980	FR	155	156	<1wk	Stroke Unit	30	18	55	43	23	75
Hamrin,1982	IR	60	52	<3days	Stroke Area	19	13	30	19	9	23
Stevens et al,1984	FR	112	116	<3wks	Stroke Unit	26	11	117	32	15	113
Sivinius et al,1985	FR	50	45	<1wk	Stroke Area	2	14	85	4	14	84
Strand et al,1985	IR	110	183	<1wk	Stroke Unit	37	8	21	62	30	31
Indradavik et al,1991	FR	110	110	<1wk	Stroke Unit	8	14	75	19	25	123
Aitken et al,1993	FR	34	33	<3days	Stroke Area	10	7	36	11	9	27

Rand: Randomisation procedure; FR: Formal randomisation; IR: Informal randomisation
SRU: Stroke Rehabilitation Unit; GMW: General Medical Wards; Entry Time: Time to entry to stroke unit
Mort: No. of patients dying within 16 weeks); Inst: No. of patients in institutions; LOS: Length of stay in days

1.5.2.2 Randomised studies

There are ten studies in the literature which have used acceptable randomisation techniques to compare outcome in stroke patients managed in specialist settings with those managed in general settings (Table 1.2).

The first randomised controlled study on stroke unit rehabilitation was undertaken in 82 patients (age range 36-82 years), 58% of whom were over 60 years of age (Feldman, Lee, Unterecker et al.,1962). There were no significant differences in outcome between the stroke unit group and control patients. The percentage of patients becoming independent increased from 3 to 45% in both groups over the 12-month period of the study (Table 1.2). It is possible that the small sample size and the heterogeneity in functional abilities of patients included in each group may have masked small differences (Type II error) which would have been apparent if a larger, more homogeneous population was studied (Lind,1982).

The Birmingham study showed a trend towards better functional outcome scores in the rehabilitation group, but this did not achieve statistical significance (Peacock, Riley, Lampton et al.,1972). It was concluded that the lengthy and expensive rehabilitation input required to achieve improved outcome would not prove to be cost-effective. However, the number of patients included in the study was small and a high proportion of control patients withdrew, weakening the power of the study.

The effectiveness of a 15-bed stroke unit was evaluated in a study undertaken in Edinburgh (Garraway, Akhtar, Prescott & Hockey,1980). Stroke patients aged over 60 years were admitted directly to the unit or to general wards no later than 3 days after the acute episode. The outcome of acute management was assessed at discharge or at the end of 16 weeks if patients continued to be in hospital. A significantly higher number of patients managed on the stroke unit were functionally independent at discharge compared with general wards (78/155 (SU) v 49/152 (GMW). The duration of hospital stay was also significantly shorter in stroke unit patients (Table 1.2). There were no significant differences in the total duration of physiotherapy (23 hrs [SU] v 42 hrs

[GMW]) or occupational therapy (36 hrs [SU] v 45 hrs [GMW]) received by patients on the stroke unit compared with general wards. There appeared to be advantages in intensive treatment of a "middle" group of stroke patients compared with those suffering from very mild or very severe deficits (Prescott, Garraway, & Akhtar,1982). The gains of stroke unit rehabilitation, however, were not present at the end of one year because some of the patients discharged from the stroke unit had lost their independence, whereas other patients discharged from general medical wards had continued to improve (Garraway, Akhtar, Hockey & Prescott,1980). The study included only 17% of the eligible patients admitted to hospital and, hence, was not generalisable. The outcome of the acute phase of rehabilitation was assessed at an inconsistent time (16 weeks or discharge) making comparisons difficult. More patients managed on the stroke unit received occupational therapy input compared with general wards (97% v 62%) and treatment was started significantly earlier on the stroke unit (7 days v 22 days) which may have significantly affected outcome (Smith, Garraway, Smith & Akhtar,1982).

In a small study in Uppsala (Hamrin,1982a,b), there were no differences in outcome (mortality: 25% v 35%; institutionalisation: 40% v 27%) between stroke patients managed on wards where staff had received specialist stroke training compared with general wards. The lengths of hospital stay were also comparable. Follow-up over a one year period did not show any differences in motor activity or ADL function between the two groups. The design of the study, however, was not strictly random but according to a fixed rota of admission. Results may have been influenced by the "spill-over" of education onto the control wards which were aware of and responded to the "competition".

Stevens and his colleagues (1984) studied the effectiveness of a 20-bed stroke unit to which patients were admitted if considered "fit for and needing rehabilitation". Survivors were screened at 4 month intervals for 1 year. Results showed a significant decrease in mortality (31% v 41%), a higher discharge rate (63% v 52%) and greater independence (47% v 38%) in patients managed on the stroke unit. The study, however, included only 36% of the patients who would be eligible to participate. Patients

on the stroke unit received significantly greater amounts of physiotherapy, speech therapy and occupational therapy which would have affected results.

A study from Umea (Strand, Asplund, Eriksson et al.,1985) showed that stroke unit management was associated with lower mortality, lower institutionalisation and decreased lengths of hospital stay (Table 1.2). Patients managed on a 6-bed stroke unit were more likely to be discharged (15% in hospital at 4 months compared with 39% on general wards) and more likely to be independent in walking, dressing and personal care. Their results also suggested that there were no differences in benefits to any particular prognostic group. The randomisation process was not strict in this study as patients were allocated to the stroke unit on a "first come, first served" basis with excess patients going to general wards. Some of the patients on the stroke unit were further randomised and included in a haemodilution trial (Asplund,1991).

A well-designed Norwegian study (Indradavik, Bakke, Solberg et al.,1991) using a consistent approach to diagnosis, treatment and disability showed that rehabilitation on a 6-bed stroke unit was associated with a higher rate of discharge (56.4% v 32.7%), lower rate of institutionalisation (36.3% v 50%), lower mortality (7.3% v 17.3%) and better functional outcome (Barthel score 79.7 v 65.8) at 6 weeks. These benefits were still present at the end of one year. Low-dose heparin was used on the stroke unit in patients with extensive hemiparesis which may have contributed to the reduction in mortality. The nature of the unit was such that it is difficult to disentangle the effects of the management of acute stroke from those of rehabilitation.

A study from Newcastle compared stroke management for elderly patients on rehabilitation wards with general wards and showed no significant differences in outcome in patients managed in either setting (Aitken, Rodgers, French et al.,1993). A high proportion of eligible patients, however, were excluded (only 67 out of 398 stroke patients were finally included) and the study was limited to elderly stroke patients admitted on general medical wards.

1.5.2.3 Conclusions on stroke units

The literature on the evaluation of stroke units suggests that:

1) Management on stroke units may be associated with reduction in stroke-related mortality. The improvement in mortality does not appear to result in an increase in morbidity. An overview of stroke trials (Langhorne, Williams, Gilchrist & Howie,1993) showed an odds reduction of 28% for mortality within 4 months (Fig 1.1) which appears to be sustained at 1 year. This odds reduction is greater than that reported for any currently available medical or surgical intervention (Sandercock & Willems,1992).

2) A significantly higher number of patients may regain functional independence on stroke units. If institutionalisation, no matter how imperfect, were to be used as a proxy measure for poor functional outcome, most studies show significant reductions for patients managed on stroke units. These studies also emphasise the importance of admission to stroke units soon after onset, early commencement of therapy and active family participation in the rehabilitation process.

3) The effect of stroke units on hospital lengths of stay remains unclear probably because this measure is liable to be influenced by hospital policy and other non-stroke related factors. There was no difference in the hospital length of stay in one study, patients on the stroke unit stayed longer in 3 studies but were discharged earlier in 3 other studies (Table 1.2).

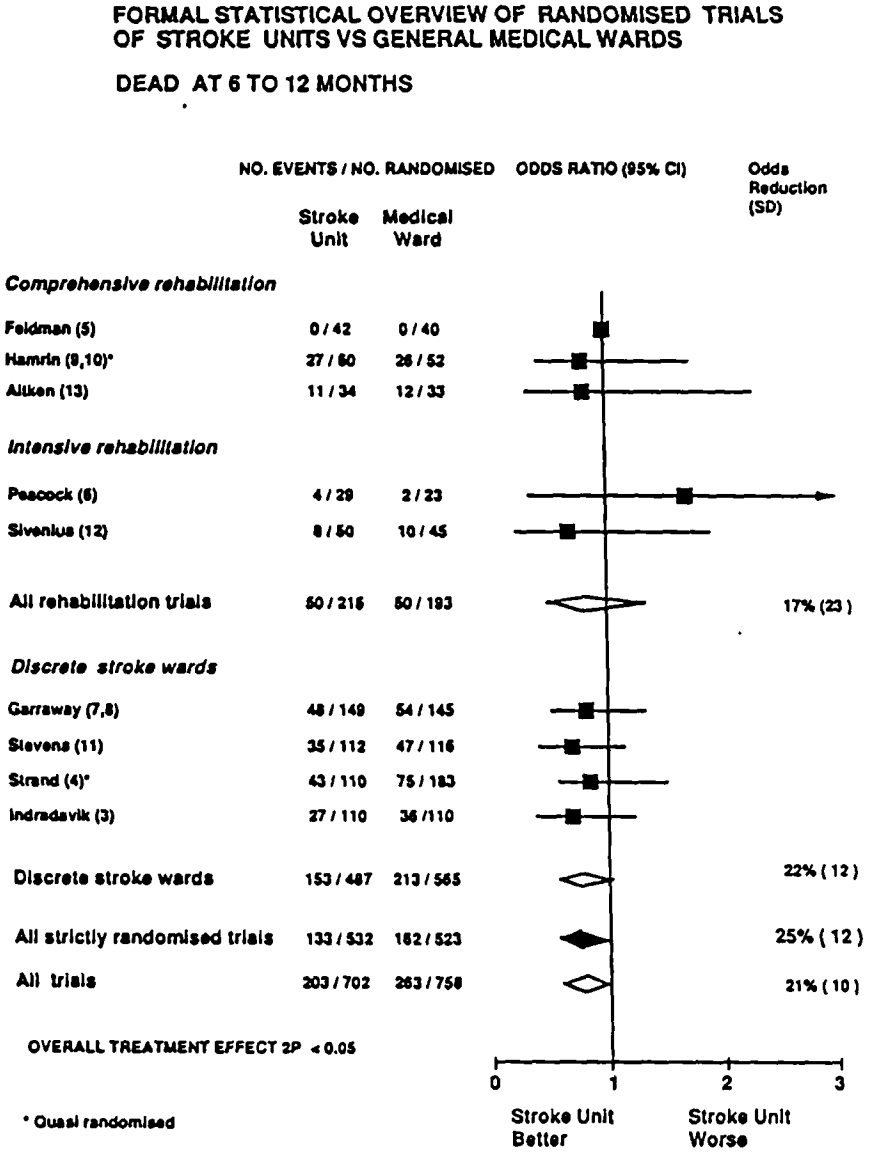

Fig 1.1 Reduction in mortality following stroke unit intervention.

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1.5.2.4 General problems in interpretation of results

Clinical practice has largely remained unchanged despite several studies showing advantages of stroke unit rehabilitation. This is because:

1) Patient selection criteria in most studies are not defined and there appears to be considerable variation in the type of patients included in different studies and even amongst patients included in the same study.

2) There is considerable variation in the number of eligible patients who were finally included in different studies. It is, hence, not possible to generalise the results of these studies to clinical practice.

3) The assessment and outcome measures used in different studies vary considerably and have been applied at different points during the rehabilitation process.

4) Despite adequate randomisation, the intensity and nature of therapy intervention has not been documented in most studies, making them difficult to interpret or replicate.

5) Some studies have proved inconclusive because of inadequate sample sizes and statistical problems.

6) The effect of publication bias in favour of "positive" studies cannot be ignored and may influence the results of overviews on the benefits of stroke unit rehabilitation.

The most important shortcomings in the current stroke rehabilitation literature centre around inadequacies in patient selection criteria and the multiplicity of assessment procedures. Although comprehensive and repeated multidisciplinary assessments of impairment and disability are the key to evaluating any rehabilitation process, there is little agreement on appropriate assessments in stroke patients. This has resulted in the use of a large number of measures which are often unstandardised and applied at different points in time during rehabilitation. Meaningful interpretation and reliable comparison of the results of future stroke studies will depend upon the development of standardised assessment procedures.

1.6 ASSESSMENTS IN STROKE REHABILITATION

Assessment in rehabilitation refers to the process of acquisition of the information needed to define rehabilitation goals. Studies on stroke rehabilitation have been hampered by the absence of a "common language" for assessment and many researchers have used their own sets of measures. This is largely because of the lack of an agreed framework or model for rehabilitation. Recent consensus on the pathology-impairment-disability-handicap model (WHO,1980; Duckworth,1984; Granger,1984) provides the basic framework for defining appropriate assessments in stroke rehabilitation (Wade,1992c). According to this model the focus for attention should pass from pathology to handicap and from patient to environment during the course of rehabilitation. Ideally, assessments should be aimed at one level at a given time and all component items should relate to the level being measured (Wade,1992c). Some overlap between assessments for different levels, however, is likely to occur in clinical settings because these levels are not discrete but form a continuum of illness.

1.6.1 Choice of measures

The importance of knowing what information is wanted and why, i.e. the "sensibility" of a measure, is central to the issue of choosing any measure in rehabilitation (Feinstein, Josephy & Wells,1986). The other necessary characteristics of a measure are validity, reliability, sensitivity, simplicity and communicability (Wade,1992c).

Stroke rehabilitation deals with the broad and often ill-defined range of human performance making it difficult to compare different patients or even monitor overall progress in individual patients (Keith,1990). A large number of neurological, physical and functional assessments with differing emphasis are currently available

(Wade, 1992c) and can be divided into global assessments, which assess the overall impact of stroke on individual patients, and specific assessments, which deal with a single levels of impairment or disability.

There are numerous scales for measuring global disease severity, which often use composite scoring systems (Wade,1986; Adams, Meador, Sethi et al.,1987; Brott, Adams, Olinger et al.,1989; Orgogozo,1989). Composite scores of global disease severity are unreliable because of the dominance of speech and language function over other indices and because various disabilities are combined into one score (Capildeo & Clifford-Rose,1979; Wade,1992c). Most scores also mix a variety of impairments and disabilities without considering their interactions (Wade,1992c). A considerable amount of work has been undertaken in developing and validating simpler and more specific measures of stroke disability which are more appropriate in assessing and comparing stroke patients and their management (Seale & Davies,1987; Keith,1990; Wade,1992c). Consequently, global measures of disease severity are probably redundant because simpler, more specific measures exist (Wade,1992c).

It is important to decide upon the least information necessary to achieve the purpose of assessment. The temptation to collect large amounts of data needs to be resisted because this is expensive in time and effort and often results in reduced accuracy and completeness of the data collected (Keith,1990). Assessment protocols based on a small selection of easy to use measures relevant to the goals of the field have been recommended for wider use (Keith,1990; Wade,1992c). It also is best to use existing measures wherever possible provided that these are valid for the purpose in mind, reliable in the circumstances proposed and appropriate to the needs and resources (Wade,1992c). Moreover, the use of existing measures also improves communicability and allows other people to understand and interpret the data presented.

1.6.2 Objectives of measurements in stroke

The major reasons to undertake assessments in stroke patients, especially for hospital-based rehabilitation, are as follows:

1) To define the type of patient by ascertaining the extent of disability and the potential for recovery and/or responding to intervention (prognostication).

2) To monitor the process of rehabilitation (evaluation).

3) To assess the degree of recovery and residual disability at the end of the rehabilitation process (outcome).

1.6.3 Prognostication in stroke

Prognosis after stroke is related directly to the severity of initial impairments and disabilities and there are several ways of predicting outcome. These may be simple, specific measures or more complex assessments including multivariate formulae. Simple measures include assessment of urinary incontinence (Wade, Skilbeck & Langton-Hewer,1983; ; Gladman, Harwood & Barer,1992), changes in conciousness levels (Teasdale & Jennett,1974) or assessment of the severity of individual motor, speech or perceptual impairments (Wade,1992c). The more complex determinations include estimation of the extent of anatomical damage (Bamford, Sandercock, Dennis et al.,1991), assessments of aggregated motor deficit (Allen,1984a,b), functional impairment scores (Shah, Vanclay & Cooper,1989; Asberg & Nyedevik,1991), or a combination of motor and functional impairments incorporated into multivariate scores (Prescott, Garraway & Akhtar,1982; Stone, Patel & Greenwood,1993).

There has been considerable controversy over the merits of various sets of prognostic indicators and their applicability to stroke research. Various studies have shown that prognostic indicators based on neurological examination can predict mortality or severe handicap (Teasdale & Jennett,1974; Allen,1984a,b; Brott, Adams, Olinger et al.,1989; Orgogozo,1989; Bamford, Sandercock, Dennis et al.,1991) but are limited in

predicting functional outcome, destination of discharge or care needs following discharge from hospital (Feigenson, McDowell, Meese et al.,1977; Prescott, Garraway & Akhtar,1982; Young,1988). Scores which include functional assessments are more predictive of functional outcome (Newman,1972; Wade, Skilbeck & Langton-Hewer,1983; Wade & Langton-Hewer,1985b; Shah, Vanclay & Cooper,1989; Asberg & Nyedevik,1991; Prescott, Garraway & Akhtar,1982; Stone, Patel & Greenwood,1993) but often involve the use of multivariate formulae. These formulae can also be used to select those stroke patients who are most suitable for specialist rehabilitation. There can be few advantages in directing intensive therapy resources towards patients who will recover well regardless of input or those who will continue to be severely disabled despite intensive therapy. Several studies have shown that there may be advantages in selecting a "middle band" of stroke patients for specialist rehabilitation (McCann & Culbertson,1976; Prescott, Garraway & Akhtar,1982; Young,1988; Anderson,1990). Concentrating on the "middle band" of stroke patients would allow more realistic comparison of the relative effectiveness of therapy interventions and models of stroke care (Garraway,1985).

There are some reservations on the use of multivariate formulae in predicting stroke outcome. A large meta-analysis on clinical prediction rules (Hier & Edelstein,1991) has shown significant methodological problems in many of the studies on prognostic indicators in stroke. These include lack of accurate demographic description of the population in question, inadequate sample size, use of large numbers of measures rarely standardised, failure to describe the methods of deriving prognostic criteria and failure to validate derived scores in wider or different datasets. Despite the emphasis on the inability of a single indicator to predict outcome in stroke (Wade & Langton-Hewer,1983; Shah, Vanclay & Cooper,1989; Anderson,1990; Granger, Hamilton & Fiedler,1992), there is a view that simple single indicators of prognosis e.g. urinary incontinence are, in fact, better predictors of outcome than the more complex multivariate formulae (Barer & Mitchell,1989; Wade,1992c,d;1993a; Taub, Wolfe, Richardson et al.,1994). The superiority of urinary incontinence over five multivariate

scales used in stroke research has been demonstrated in a recent study (Gladman, Harwood & Barer,1992). There also is concern that triage criteria for intervention are poorly developed and still too unreliable to allow negative selection on a rational basis (Wade,1992d).

Review of the literature highlights the inadequacy of existing prognostic scales to stratify stroke patients for controlled studies of stroke rehabilitation (Hier & Edelstein,1991; Wade,1992d,1993a). Further work is required to characterise the "middle prognostic band" of stroke patients, which can then be incorporated into simple, easy to use, reliable and sensitive criteria. The issues raised by Hier & Edelstein (1991) should be recognised in developing new prognostic stratification criteria, as well as the need to compare new scales with existing validated scales (Gladman, Harwood & Barer,1992) so that their applicability to practice and research is clearly demonstrated.

1.6.4 Monitoring rehabilitation

The large number of impairments and disabilities associated with stroke as well as the large number of measures available to measure each impairment and disability have contributed significantly to the lack of a common assessment data-set for stroke research. This problem has been addressed by the British Stroke Research Group, which has recommended a basket of assessments in stroke (Wade,1992c,d;1993a). Assessments included are well-validated, reliable and pertain to key areas in stroke rehabilitation. Core assessments include Motoricity Index and Trunk Control Test for motor loss (Collin & Wade,1990), Star Cancellation Test for neglect (Halligan, Marshall & Wade,1989), Frenchay Aphasia Screening Test for aphasia (Enderby, Wood, Wade & Langton-Hewer,1986), Hodkinson Mental Test for orientation and memory (Hodkinson,1972), Barthel Activities of Daily Living Index (ADL) for functional abilities (Collin, Wade, Davis & Horne,1988), Rivermead Mobility Index (Collen, Wade, Robb & Bradshaw,1991) and a Timed Walking Test (Wade,1992c). Several other

assessments are also recommended which can be used in specific circumstances (Wade,1992c).

Despite agreement on what should be assessed and how it should be measured, the number of assessments recommended remains large and it may not always be possible or necessary to undertake all, especially if repeated measurements are needed. A sensible approach would be as follows:

1) Select a basket of measures most appropriate to the objectives of measurement and the environment in which this assessment is undertaken (Section 1.6.1).

2) Undertake a comprehensive assessment of impairment and disability at the commencement of the rehabilitation process and then repeat these assessments at the end of rehabilitation.

3) Use simpler assessments more frequently during the rehabilitation process to monitor and adjust the treatment programme.

The use of activities of daily living scales may be most appropriate in monitoring the process of rehabilitation. Although achieving independence in basic activities of living and mobility is not equivalent to complete success in rehabilitation, without this independence further progress would be difficult (Wade,1992c). Several reviews (Donaldson, Wagner & Gresham,1973; Deyo, 1984; Law & Letts,1989; Eakin 1989; Barer & Nouri,1990) suggest that there is general agreement on the "core" activities of daily living (bladder & bowel function, feeding, cleanliness, dressing and mobility). Assessment of these activities forms the basis of all ADL scales used in stroke rehabilitation (Wade,1992c). Although the development of ADL scales has followed observed practice rather than being developed from a consistent theory or framework, ADL appears to be a valid unitary phenomenon and a suitable measure of rehabilitation outcome (Norstrom & Thorslun,1991). It is, hence, no surprise that a review of studies on stroke rehabilitation showed a predominance of ADL scales in monitoring the rehabilitation process (Seale & Davis,1987).

ADL scales do not exclusively deal with disability but often include items which could be considered impairments. Several activities in ADL scales are influenced

by impairment and the distinction between an impairment and a disability can often be blurred. In addition, items in ADL scales are not exclusive in themselves and may depend upon other activities being assessed. The importance of ADL scales lies in their ability to measure the valid and important sphere of dependence on others in fundamental daily activities. The validity of ADL scales is also enhanced by the fact that they have been developed in response to clinical needs. Equally important, the results of ADL measures have been comparable regardless of the methodology of collection, suggesting a high degree of reliability and reproducibility with these scales (Sheikh, Smith, Mead et al.,1979; McGinnis, Seward, DeJong,1986; Collin, Wade, Davis & Horne,1988).

The major limitation of ADL scales is that they have a profound ceiling effect. They cannot measure detailed changes in specific terms or guide specific treatment approaches (Wade,1993c). The ordinal properties of the scale need to be recognised and a change in score cannot be used as a sole comparative measure without reference to the patients being studied, especially to their prognostic expectations. Other limitations include the inability to measure or identify the reasons why patients fail to achieve tasks, or how patients achieve independence (the quality of functional recovery). In addition, these scales cannot measure other aspects of disability (eg communication or orientation) despite being influenced by them.

1.6.5 Measurement of outcome

The measurement of successful recovery after stroke has been a major focus of stroke research. As "successful outcome" means different things to different people (eg. patients, carers, professionals), evaluation of outcome after stroke rehabilitation is complex and it has been consistently difficult to identify one single outcome measure which will satisfy all needs. Measures such as mortality and handicap have been used in epidemiological research in stroke for a long time. Judging the outcome of rehabilitation, in contrast, depends upon assessment of a broad range of

ill-defined functions (Keith,1990) and requires the use of more complex and sensitive measures (Wade,1992b).

The recommended minimum outcome information required in normal clinical practice is the Barthel ADL index (Wade,1992b). This index is of considerable importance because it concentrates upon the patients' need for help with those personal activities which need to be undertaken on most days of the week. It is also an important surrogate indicator of quality of life because most of the quality of life measures are primarily concerned with ADL functions (Wade,1992c). In a recent study, Barthel scores were shown to have a good correlation with the Rankin Handicap Scale and had the advantage of better inter-rater reliability (Wolfe, Taub, Woodrow & Burney,1991). In addition, ADL measures have been used in the vast majority of stroke studies (Seale & Davis,1987), which allows some comparison between studies.

Three additional outcome measures are important in hospital settings. Mortality continues to be an important outcome measure because of its inclusion in several epidemiological and stroke outcome studies. A recent meta-analysis on stroke outcome has used mortality as the sole comparative measure because it was considered to be "not subject to observer bias" (Langhorne, Williams, Gilchrist & Howie,1993). Mortality in stroke can be divided into three phases: a) early mortality due to irreversible brain damage which is unlikely to be influenced by rehabilitation, b) delayed hospital mortality due to stroke-related complications which is an indicator of quality of care, and, c) late mortality which is multifactorial depending upon the severity of stroke, rehabilitation, care requirements, community intervention and co-morbidity (Kelly-Hayes, Wolf, Kannel et al.,1988).

The setting to which an individual is discharged after rehabilitation with reference to pre-morbid accommodation has long been one of the most ubiquitous of outcome indicators (Keith,1990). Institutionalisation has immediate implications of "unsuccessful" rehabilitation, suspension of the right to live at home and those of the costs to social services and to society. However, destination of discharge is dependent not only on the level of residual disability or success of rehabilitation but is also influenced

by co-morbidity, family support and social variables which may be outside the control of the rehabilitation process (Bishop, Epstein, Keitner et al.,1986; Kelly-Hayes, Wolf, Kannel et al.,1988; Ebrahim,1990; Smith 1990). Although limited in its ability to judge stroke outcome, the scale of use of institutionalisation as an outcome measure in research makes this statistic particularly useful (Keith,1990; Wade,1992b).

Length of hospital stay is fast becoming a prominent outcome measure in the current climate of healthcare provision. Length of hospital stay is often policy driven and influenced by several factors such as availability of beds, pressure on services and financial constraints in insurance-driven systems. Despite these limitations, it is increasingly being seen as a proxy measure for the efficiency of the rehabilitation process, especially for organisational aspects aimed at expediting discharge from hospital once rehabilitation goals have been achieved (Consensus Conference,1988; Wade,1993b). In the British system, length of hospital stay remains an important determinant of the overall hospital cost of stroke (OHE,1988) and is important in planning the delivery of health services for future.

In conclusion, it is clear from the literature that no single outcome measure can reliably assess all aspects of stroke rehabilitation. In general, it is more appropriate to use a combination of measures to evaluate the effectiveness of management strategies.

1.7 SUMMARY OF THE REVIEW OF LITERATURE

1.7.1 General Conclusions

There is little evidence to suggest that acute intensive care units significantly affect stroke outcome (Millikan,1979; Garraway,1985; Indredavik, Bakke, Solberg, et al.,1991; Wade,1992a). The emphasis, at present, should therefore be on improving prognosis and limiting disability in patients surviving the acute episode by

determining the most effective means of rehabilitation for stroke survivors. Despite several studies attempting to evaluate different approaches to stroke rehabilitation, none of them has resulted in widely accepted major changes in clinical practice. The evaluation of rehabilitation and service organisation presents particular problems because:

1) Rehabilitation trials cannot be "double-blind"; hence, strenuous efforts need to be made to ensure that the processes of patient selection, treatment allocation, obtaining consent and outcome assessment are free of bias.

2) The criteria for selecting patients for stroke trials and the methods used for prognostic stratification are complex and need to be standardised.

3) The present chaotic diversity of functional assessments and outcome scales should be reduced to a small standard set of appropriate, valid, reliable and responsive measures. There needs to be a mechanism for ensuring easy multiprofessional access to multidisciplinary assessments which will promote team-work, enhance proactive patient management and facilitate research.

4) There should be a standardised system of classifying, measuring and timing rehabilitation interventions. The diverse professions, specialities, approaches and working practices need to be accommodated within study protocols.

1.7.2 Ideal study design

Despite the problems in evaluation, it should still be possible to study specific interventions following a well-defined protocol. The simplest experimental design to assess the overall benefit of a stroke rehabilitation programme is the randomised study, with patients matched for age, sex, side of stroke and severity of

neurological and functional impairment (Reding & McDowell,1989). Three end points are of interest:

1) the final level of functional outcome.

2) the time interval required to reach the outcome goal.

3) the number of patients discharged home compared with discharges to institutions.

A second set of analyses would categorise patients according to the severity of neurological and functional deficits to assess whether there was a differential benefit for more impaired patients compared with those with less significant impairments (Reding & McDowell,1989).

Worthwhile evaluation of the effectiveness of stroke management can only be undertaken using methods which can be implemented easily in routine clinical practice and in any setting. As there is considerable variation in stroke severity and outcome, there needs to be a reliable system to stratify patients according to prognosis and so facilitate more detailed evaluations. Inclusion criteria should enable the majority of stroke patients presenting to the service to be included so that the results are applicable to mainstream clinical practice.

1.7.3 Purpose of the present investigation

The current state of affairs is summarised in Professor Isaacs' comment that "experts in stroke rehabilitation abound, but none of them has ever proven anything about rehabilitation to the satisfaction of anybody else" (Isaacs,1978). The main problem stems from the dearth of methodologically sound studies, a point on which all contributors to this controversy agree (Hachinski,1989). The present thesis is an attempt to address some of these issues. It describes and evaluates methods of stratification according to prognostic expectations in stroke patients and multidisciplinary data collection using a set of well-validated assessments. These methods are then used to assess the effectiveness of stroke unit rehabilitation in different patient groups.

1.8 OBJECTIVES OF THE THESIS

1) The development of criteria which will allow stratification of stroke patients. This involves:

a) identification of major clinical determinants of outcome.

b) derivation of prognostic criteria based on these determinants.

c) prospective assessment of prognostic criteria in predicting outcome.

2) The development of reliable data collection techniques in stroke rehabilitation. This involves:

a) development of a multidisciplinary stroke management system.

- assessment of "user-friendliness" of the system
- assessment of the quality of data collected

b) definition of measures of process in stroke rehabilitation.

- measures of therapy input
- measures of outcome

3) An evaluation of the effectiveness of stroke unit rehabilitation. This involves comparing rehabilitation on a specialist unit with general wards for:

a) differences in therapy input and outcome.

b) differences in speed of functional recovery.

c) effects of age on benefits from stroke unit rehabilitation.

4) Proposal of a set of realistic measures to evaluate and compare the effectiveness of stroke rehabilitation in different settings.

CHAPTER 2. METHODS I: AN INTEGRATED SYSTEM FOR MULTIDISCIPLINARY ASSESSMENTS IN STROKE.

2.1 INTRODUCTION

Comprehensive measurement of recovery after stroke is essential not only for optimal clinical management of patients but also important in stroke rehabilitation research. Many of the evaluations required, however, fall outside traditional clinical evaluation and therefore receive little attention from physicians (Tinetti & Ginter,1988; Applegate, Blass & Franklin,1990). The importance of including functional assessments, in addition to clinical evaluation, in monitoring stroke rehabilitation has been emphasised in several overviews (Gresham,1986; Seale & Davies,1987; Ebrahim,1990; Smith 1990; Keith 1990; Wade, 1992 a,b).

As stroke rehabilitation deals with a broad and often ill-defined range of human performance (Keith,1990), a large number of neurological, physical and functional assessments have been developed (Wade, 1992c). A review on the use of outcome measures in 50 major studies has shown the predominance of Activities of Daily Living (ADL) scales for capturing the complex treatment outcomes of multidisciplinary team input (Seale & Davies,1988). In addition, a large number of scales measuring different aspects of rehabilitation have been used in these studies making comparison of results difficult. It has, hence, been suggested that it may be more appropriate to select a few measures in principal areas of assessment which are central to the goals of the rehabilitation programme and to concentrate on their continuing development (Keith,1990).

The reliable collection, storage and retrieval of data has been another major problem in stroke rehabilitation research. Data available to date are considered to be

of limited value, being incomplete and of poor quality (Wade,1992a). This is not surprising considering the multidisciplinary nature of the data, which is collected by a number of different professionals in different formats and stored on sites often remote from patients. Access to data also is limited by problems of perceived ownership which further restrict dissemination of information and encourage duplication (Consensus Conference,1988).

As a result of these considerations, it was decided to develop an integrated computerised multidisciplinary data collection system for studies in stroke rehabilitation which would:

1) incorporate a small number of well-validated assessments considered to be important in managing stroke patients by the multidisciplinary team, especially in the hospital setting.

2) be ward-based, so that it was in close proximity to the patients on whom the data was collected.

3) store data in an easily retrievable format with access for appropriate members of the multidisciplinary team as well as for studies on stroke rehabilitation.

The integrated stroke assessment and management system was developed in collaboration with Dr Adrian J. Fowle who provided the computing and programming skills required for the project. It was piloted during the initial studies on the development of the Orpington Prognostic Score (Chapter 6) and used in collecting data for studies on stroke unit rehabilitation (Chapters 7, 8 & 9). A description of the system and an evaluation of its applicability to stroke rehabilitation settings is presented in this chapter.

2.2 THE ORPINGTON STROKE MANAGEMENT SYSTEM (OSMS)

2.2.1 Description

The Orpington Stroke Management System (OSMS) is a multidimensional computer programme which offers facilities for:

1) integrated multidisciplinary data collection in stroke patients.

2) ward-based monitoring of progress during rehabilitation.

3) generating ward reports and multidisciplinary discharge summaries.

4) regular audit of clinical practice and quality of services.

5) research, by stratifying stroke patients according to prognosis and assessing changes in a range of abilities following medical or therapy intervention.

6) creating a database of stroke patients for epidemiology and service needs.

The system has been developed specifically for day to day use on stroke and rehabilitation wards. It is designed for multidisciplinary use and is sufficiently simple and robust to be operated by people with little or no computing background. Help and instructions are offered "on-line" to ensure accuracy of data input and to help save time.

2.2.2 Hardware and Software

The programme requires a 486 IBM compatible PC with a processor speed of 20 Mz or above. A minimum of 100 Megabytes on the Hard Disk Drive is recommended to maintain a reasonable number of patient records (approximately 800-1000 records). The current programme requires Smartware II v1.5 to integrate database, spreadsheet and wordproccessor functions. The Smartware also facilitates communications and shared databases with other remote users via a modem.

2.2.3 Components of OSMS

The primary components OSMS are:

1) Patient assessment module.

2) Patient administration module.

3) Audit and quality module.

4) Secretarial support module.

2.2.3.1 Patient Assessment Module

This module stores data from comprehensive multidisciplinary assessments collected at the time of admission, before rehabilitation and at the time of discharge (Appendix III). It can be used to monitor motor, mobility and functional changes in patients during the rehabilitation process. Assessments included in the integrated system combine measures of impairment and disability considered to be important in stroke rehabilitation. The emphasis is on monitoring functional recovery, based on measures of ADL, because this is considered vital in rehabilitation (Wade,1992c). Assessments were included after discussion with all members of the multidisciplinary team (Table 2.1).

Assessments are grouped according to the traditional roles of rehabilitation staff (eg motor & mobility assessments for physiotherapists, function & perceptual assessments for occupational therapists, speech, language & swallowing assessments for speech therapists) for simplicity in data entry and to save time. The programme has the flexibility to change, add or delete assessments within each discipline and to be customised to the needs of individual rehabilitation settings. The systems manager has access to all assessments in the system. The multidisciplinary assessments format is intended to facilitate evaluation of change following acute therapeutic intervention, new rehabilitation techniques or changes in management strategy for stroke.

Table 2.1 Assessments in the OSMS battery.

Consciousness	Glasgow coma scale (Teasdale & Jennett,1974)
Medical	Extent and severity of neurological deficit Anatomical localisation Risk factors Additional disability
Prognosis	Edinburgh Prognostic Scale (Prescott et al., 1982) Orpington Prognostic Scale
Self Care	Barthel ADL (Collin et al.,1988) Northwick Park ADL (Benjamin,1976)
Social Functioning	FAI (Wade, Legh-Smith, Langton-Hewer,1985)
Cognition	Hodkinson's MTS (Hodkinson,1972)
Dysphasia	Frenchay Aphasia Screening Test (Enderby et al.,1986)
Perception	*Battery based on RPAB (Whiting et al.,1985)
Motor Power	Motoricity Index (Demeurisse et al.,1980)
Mobility	Functional Ambulation Categories (Holden et al.,1983)
Mood	HADS (Zigmond & Snaith,1983)

ADL: Activities of Daily Living
MTS: Mental Test Score
FAI: Frenchay Activities Index
RPAB: Rivermead Perceptual Assessment Battery
HADS: Hospital Anxiety and Depression Scale

* The battery included is an abbreviated version of RPAB and is currently being validated on the stroke unit.

Justification for inclusion of assessments is discussed in Section 2.4.1

2.2.3.2 Patient Administration Module

The patient administration module deals with items such as patient details, source of admission and destination of discharge, mode of referral, and intervals between stroke, admission, referral, and transfer to stroke unit. These are stored on a separate database and are available for administrative use. Details of general practitioners in the district are held on a GP database and are automatically appended to the patient records. A facility to download patient details directly from hospital systems such as Patient Administration System or Casemix can be incorporated when links with these systems are available.

2.2.3.3 Audit and Quality module

OSMS can produce reports on audit measures for periods of time specified by the user. It also has the capacity of showing trends in these variables derived from data collected over a period of time. Ten standard indicators are measured by the programme (Table 2.2). The users can pre-define quality norms for each of the listed indicators which will be automatically audited for the period specified. In addition to standard indicators listed, new indicators, customised for the user group can be included in the programme.

2.2.3.4 Secretarial Support Module

OSMS has the capability to generate reports of admission details, progress of individual patients, ward notes and discharge summaries. The ability to supply comprehensive information at short notice can significantly improve communication and the quality of service provided in multiagency and multidisciplinary settings, frequently encountered in stroke rehabilitation.

Table 2.2 Standard variables measured by OSMS.

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1) Number of patients admitted.

2) Number of patients discharged.

3) Length of stay of all patients *(mean and median)*.

4) Delay between referral and transfer of patients *(mean and median)*.

5) Percentage of patients with Orpington Score 3-5 at 2 weeks discharged home.

6) Percentage of discharged patients with a Barthel Score of >11.

7) Percentage of discharged patients improving their Barthel Score by >5.

8) Percentage of patients discharged to institutional/long-term care.

9) Median (or mean) length of stay for:

    a) Patients discharged home or to relatives.

    b) Patients discharged to institutional care.

10) Bed occupancy.

2.2.4 Security

The Data Protection Act requires that computer based systems which hold patient information are registered under the Act, access to information is protected and that all users are aware of the requirements of the Act. Security measures to protect information held on the databases have been incorporated into the system which will allow only authorised users to access the system. There is a log-in facility and a record is maintained. Each user has a unique, self-determined password inaccessible to other users. Different users can have different levels of access which can be determined by the systems manager. The list of users can be amended by the systems manager and passwords changed by individual users.

2.2.5 Training facilities

Adequate training of users on any computer system is essential for its effective functioning (Zoltan-Ford & Chapanis,1987). Complex systems which require specialist training frequently present problems of reliable and accurate data input (Young,1990). A major objective of the development of OSMS was to keep it operationally simple and to ensure that only basic keyboard skills were required to operate the system. It is possible for the main operator to train multidisciplinary staff "in-house" using the facilities of the training programme. The training mode is similar to the real mode but data entered is not stored in any of the "real" databases. This allows staff to learn to use the programme at their own pace without fear of corrupting data. The top line of all windows of the training mode is clearly labelled and has a different colour (Magenta) from the real mode (Green) to prevent mistakes. Training sessions normally require about 30 minutes per user to attain a good level of proficiency.

Future Developments:

OSMS is a clinical stroke management programme developed with ongoing multidisciplinary input to meet the data collection requirements of specialist stroke rehabilitation services regardless of their setting. The assessments and the variables in the databases can be modified easily in line with developments or changes in rehabilitation practices on the unit. The system has the flexibility to be customised to other stroke units and has been installed on the stroke units at Canterbury and at St. Thomas's Hospital, London. There is an ongoing programme to monitor the system for performance with a view to continuing development to resolve the unmet needs identified by new users and to be responsive to changing needs in future.

OSMS offers quantitative measures of the process and outcome of stroke rehabilitation which will facilitate "needs" assessment and monitor the quality of service offered. The programme also has applications in clinical and health delivery research. Modified versions of OSMS, which can be used in situations other than stroke (e.g. Parkinson's disease, geriatric-orthopaedic rehabilitation) are being developed and should provide a comprehensive information system for rehabilitation.

2.3 EVALUATION OF THE INTEGRATED SYSTEM

2.3.1 Method

The integrated system was installed on a stand-alone computer with a dedicated printer based in the nurses' office on the stroke rehabilitation unit. A brief presentation on the development, potential applications and perceived operation of the system was made to the medical, nursing, therapy and secretarial staff who were likely to be involved in stroke rehabilitation. The system was registered under the Data Protection Act and all staff likely to be involved with data entry or retrieval were made aware of the

requirements of the Act. The system was also registered on the NHS Register of Computer Applications (Region G: SE Thames; Key: 630G055).

Medical, nursing and therapy staff directly and regularly involved in the assessment and treatment of patients on the stroke rehabilitation unit over the six-month pilot evaluation period were identified as primary users regardless of their enthusiasm for the system. These included 2 doctors, 7 nurses, 2 physiotherapists and 2 occupational therapists. Primary users were given individual training sessions either by A. Fowle or L. Kalra (system developers) lasting for 30 minutes each. The proficiency of users was verified at the end of the session by the trainers observing unsupervised data-entry on the training module. Provisions were made for further training if considered necessary by the trainer during the assessment.

A 3-month period was allocated for training, post-training familiarisation and resolving software problems prior to formal evaluation. Data entry during this period was unrestricted and not monitored. Patients' progress was monitored and clinical decisions were taken on the basis of conventional paper records maintained according to existing practices. A record of software problems or difficulties encountered in data entry (e.g. computer failures, difficulties in accessing patient or assessment files, ability to change incorrect entries, multiple data entries) was kept, which were resolved by modifying the programme.

The functioning of the integrated system in day to day work on the stroke rehabilitation unit was assessed during a 6-month study period by using:

a) User surveys for ease of operation and acceptability, and

b) "snapshot" of the database for completeness and accuracy of "index" assessments.

A user survey (Appendix IV) was undertaken at the beginning and end of the 6-month evaluation period in primary users of the system as defined previously. The questionnaire covered areas ranging from ease of data entry to increase in workload and perceived benefits of the system in patient care and research. The "workload to benefit

ratio" of the system as perceived subjectively by the primary users was also assessed. The data collected in the two assessments were analysed using the Wilcoxon signed rank test for paired data.

Data in the databases were reviewed at the end of the 6 month period for the following "index" assessments to be completed by relevant professionals:

On Admission:

1) Patient and admission details (Körner data): Nurses.
2) Premorbid Frenchay Activities Index: Nurses.
3) Medical examination and stroke risk evaluation: Doctors.
4) Orpington Prognostic Score: Physiotherapists.
5) Functional Ambulation Categories: Physiotherapists.
6) Barthel Activities of Daily Living Index: Occupational Therapists.

Weekly monitoring:

1) Functional Ambulation Categories: Physiotherapists.
2) Barthel ADL index: Occupational Therapists.

At discharge:

1) Discharge arrangements: Nurses.
2) Functional Ambulation Categories: Physiotherapists.
3) Barthel ADL Index: Occupational Therapists.

Data held on the databases were compared with conventional paper records in each discipline for missed assessments, completeness of entries and for accuracy of data entry.

2.3.2 Results

2.3.2.1 User survey

The user survey undertaken at the beginning of the study showed that most users had previous experience (acquired during training) with the integrated data management system and felt confident operating the system (Table 2.3). The "on screen" instructions and training facilities were considered adequate (Table 2.3). Although all users thought that their workload had increased, estimates varied from less than 15 minutes per week to over an hour per week. There were doubts about the information collected being relevant to patient care, audit or research (Table 2.3).

The second survey at the end of the evaluation period showed that confidence in operating the integrated assessments system had increased significantly during the evaluation period (Fig 2.3). The frequency of use had increased but users were spending significantly less time per session than previously (Table 2.3). The actual increase in workload was less than that estimated in the previous survey ($p<0.02$) and appeared to be balanced by perceived benefits in patient care, audit and research. Potential for benefits was considered to be the greatest in areas of patient care (Table 2.3). It was not possible to assess inter-professional differences because of the small number of users in each group. Comparison of nurses with all other groups, however, did not show any significant differences. Ability to retrieve information was seen as a positive benefit with research potential for individual disciplines. Most users wanted to increase the amount of information collected for their discipline.

Table 2.3 Results of OSMS users survey (Appendix IV) undertaken at the beginning and the end of a 6 month evaluation period on the stroke unit in multidisciplinary users (n=13).

	no. of responses		
	Initial	Final	p
Duration of use:			
<1mth	3	0	-
1-3 mths	8	0	-
>3mths	2	13	-
Frequency of use:			
<1/wk	7	0	-
1-2/wk	6	7	-
>2/wk	0	6	-
Time spent/session:			0.006
<15 mins	0	6	
15-30 mins	5	6	
>30 mins	8	1	
Confident in operating OSMS:	7	13	0.04
Instructions adequate:	13	13	-
Training mode helpful:	11	-	-
Increase in workload:			0.02
no increase	0	0	
< 15 minute/week	1	1	
15-30 mins/wk	3	6	
30-60 mins/wk	5	6	
>60 mins/wk	4	0	
Benefits in:			
patient care	5	11	0.04
audit	4	9	NS
research	1	5	0.05
Workload balanced by benefits	5	12	0.05
Better discharge summaries	8	12	NS

2.3.2.2 "Snapshot" of Data Entry

Data in the databases of the integrated system were reviewed for accuracy and completion on a copy of the data taken as a "snapshot" at the end of the 6 month evaluation period.

GP File:

The general practitioner database was created from the Patient Administration System database of general practitioners working principally within the Bromley Health District. This was supplied by the Information Technology Department of Bromley Hospitals NHS Trust and consisted of 295 names at the beginning of the evaluation period. Another 12 general practitioners had been added to the system during the study period. Of these, 7 were complete and accurate entries, one entry was incomplete with the address of the surgery missing and 2 were unnecessary duplicates. One patient was assigned a non-existent general practitioner. One entry in the GP file was clearly meant to be a patient who had also been entered in the patient file.

Patient File:

The patient file database consisted of basic demographic and Körner data. Sixty-seven patients had completed hospital spells on the stroke unit during the evaluation period. All patients in the evaluation period had been registered. There was only one duplicate entry and one patient had only his name and hospital number entered. All record numbers were unique except for the duplicated patient. There were no nonsense entries. The layout and formatting of names, addresses, postcodes and telephone numbers were very variable, despite help from the programme and constant reminders to use the correct format. Nevertheless, the information was present. Only one address was so incomplete that a local postman might not have delivered to it.

Basic demographic data (age, gender, marital status, residence) had been accurately recorded for all patients except for minor misinterpretations. Four patients were given a residence code of 99 - ("other"). In each case, the accompanying text was for some sort of rented accommodation, suggesting that 11 - ("own home") might have been a better choice. One of the four temporary addresses on record was the same as the patient's permanent address. Next of kin information was missing altogether in 7 records and was insufficient to contact the person in 1 additional record.

In-patient File:

The in-patient file database held information on the date of stroke, referral for and transfer to specialist rehabilitation, discharge arrangements, as well as data on wards and consultants involved. All patients registered on the patient file had in-patient records. Three in-patient records had no dates for any of the events from stroke onset through to transfer to the stroke unit (eg. date of referral, date of assessment or date of transfer to the stroke unit). There were 2 patients with duplicate in-patient records of whom one had 2 genuine admissions. One patient known to have been admitted twice had only one admission record. The dates that were entered were all correct. Ward details and consultants were correctly entered. Discharge arrangements entered on the integrated database agreed with conventional records and were accurately incorporated into multidisciplinary discharge summaries.

Medical History File:

The medical history file database contained details of medical history, clinical examination and stroke risk assessment and management as described earlier. Seven of the 67 stroke patients (11%) had incomplete medical records on the integrated database despite complete conventional medical records being available. Six patients had more than one medical history entered. Of these, one was due to a duplicate in-patient

record, and another was a reassessment. There were 4 avoidable duplicates. All the medical history records were properly attached to the patient and in-patient records.

Assessment File:

There were 1046 assessments entered into the system on the 67 patients. These included 67 Frenchay Activities Index assessments, 67 assessments of prognostic scores, 467 Barthel ADL Index scores and 445 Functional Ambulation Categories scores. There were no instances where two or more similar assessments were entered for the same patient by the same assessor in any one day. All assessment records were properly attached to both patient and in-patient records. All patients had appropriate nursing and therapy data entered at admission and on discharge with no errors in information.

Frenchay Activities Index (FAI) had been recorded in both the integrated database and conventional records for all but 2 patients, in whom this assessment was apparently not undertaken (100% complete data). One patient had a duplicate (FAI) record in the integrated database, entered by two different nurses on two different occasions. The integrated system had complete records of Barthel Index on admission and at discharge for all patients which corresponded with conventional records. Of the 359 other Barthel assessments possible, 338 (94%) had been undertaken, of which 333 (98%) had been recorded on the integrated database. Scores recorded on the integrated database were similar to those on conventional records.

Correct prognostic scores had been entered into the system at the time of admission for all patients. The integrated system had complete records of Functional Ambulation Categories (FAC) on admission and at discharge for all patients which corresponded with conventional records. Of the other 359 FAC scores possible, 311 (87%) had been recorded on the integrated database. Conventional records were only available for 308 (86%) assessments and agreed with computer records.

2.4 DISCUSSION

The evaluation showed that it was possible to introduce an integrated computer-based multidisciplinary assessment system for patient management on rehabilitation wards without needing extra resources over and above those required for the computer hardware and programme and initial "in-house" training time which was limited to 30 minutes per member of staff in most cases. The user survey showed a high level of acceptability among all professionals involved in rehabilitation, especially after a period of routine use on the ward. The completeness and accuracy of data entry were similar to conventional records maintained by individual professions with very few omissions (<5%) compared with conventional records.

2.4.1 Choice of assessments

Stroke causes a wide range of disabilities making it difficult to compare different patients or even monitor overall progress in individual patients. The consequence of this has been the development of a large number of scales for global disease severity as well as simpler and more specific measures of stroke disability (Chapter 1). As this has resulted in considerable confusion and controversy in stroke rehabilitation research, assessment protocols based on a small selection of easy to use measures relevant to the goals of the field have been recommended for wider use (Chapter 1). This approach has been adopted in developing the integrated stroke assessments system which includes one or two well-validated simple measures for important areas in stroke rehabilitation (motor impairment, speech and language function, activities of daily living, perceptual problems and emotional status).

Repeated assessments of physical functioning and activities of daily living have been used as measures for monitoring progress in the integrated system. Several reviews of ADLs and their measures (Donaldson, Wagner & Gresham,1973; Deyo, 1984;

Law & Letts,1989; Eakin 1989; Barer & Nouri,1990) have shown a general agreement on the "core" activities that everyone will need to accomplish on a daily basis for "independent living". These "core" activities are incorporated in the Barthel ADL Index which has been included in the integrated system. The Barthel Index is well-validated (Wade & Collin. ,1988), correlates with clinical impression and is reliable on test-retest, between observers and within different settings (Collin , Wade, Davis et al,1988; Wade,1992c). It also is the most widely-used and probably the best standard monitoring and outcome measure of ADL functions (Wade,1992c).

Mobility is another important issue in stroke rehabilitation (Chiou & Burnett,1985; Martin, Meltzer & Elliot,1988). Although there are several ways of assessing mobility, there are reservations about individual measures (Grieve,1980). The Functional Ambulation Categories, incorporated into the integrated assessment system, was specifically designed for use in therapeutic environments such as the stroke unit (Holden, Gill, Magliozzi et al,1984,1986). This categorisation gives details of physical support needed by patients when walking and, hence, is most useful in active rehabilitation (Wade,1992c). The scale is simple to use, sensitive to changes during the transition from being immobile to walking with established validity and reliability (Holden, Gill, Magliozzi et al,1984,1986; Collen, Wade & Bradshaw,1990).

In addition to ADL and mobility, the integrated system has the capacity to record a range of other assessments for impairment and disability as described earlier. The inclusion of these assessments gives the system flexibility to be used as a research tool when investigating pharmacological or therapy interventions. It is important that the number of assessments undertaken as a part of routine patient management be kept to a minimum to ensure complete and accurate data entry. It is suggested that Barthel ADL Index and the FAC be used as primary measures because without achieving independence in basic activities of living and mobility, further progress in rehabilitation is difficult (Wade,1992c). The need and frequency of other assessments included in the system needs to be dictated by the specific needs of individual patients.

2.4.2 Integrated assessments systems in clinical practice

Despite the need for integrated assessments systems being well-accepted, their slow introduction in clinical practice has been well-recognised (Young,1990). This has been partly due to technical problems in developing adequate systems (Lincoln,1983), which has been overcome by recent advances in computer technology and the development of clinical systems (Young,1990). Another important factor in the slow introduction of integrated clinical systems has been the personal perceptions of eventual users, ranging from outright suspicion (Schwartz,1970; Levinson,1983; Young,1984) to doubts about their "cost (workload) to benefit ratio" (Glantz,1978). Another significant change in recent years has been the increasing acceptance of computers in medicine (Zoltan-Ford & Chapanis,1987) which is essential for the successful implementation of integrated systems, such as the OSMS, in clinical practice.

Certain guide-lines were observed in the development of the integrated assessments system. There was enough information in the literature to suggest that it needed to be non-threatening (Teach & Shortliffe,1981), simple to use and relevant to "core activities" in clinical management (Young,1990). Rather than try to achieve the ideal stroke assessment which would require the inclusion of comprehensive and often complex scales, the system was designed to include practical assessments relevant in day-to-day practice in order to improve acceptability. It was also decided not to rely solely on doctors but to involve all professionals in its development so that there was a sense of co-ownership and commitment from all professions. Finally, adequate training was provided, the reasons for use and potential benefits were explained and an opportunity for experimentation with the system was provided prior to its formal introduction. All these factors may have contributed significantly to the successful implementation of the system as shown in the study.

As expected, the user survey at the end of the evaluation period showed greater acceptability and improved proficiency in managing integrated datasets compared with the initial survey. A significantly greater number of users saw potential benefits and

felt that the "workload to benefit" ratio favoured regular use. This was corroborated by the completeness of data and its accuracy when the databases were explored. In contrast to previous studies which have suggested more positive attitudes and compliance amongst medical staff compared with other professionals involved in patient care (Reznikoff, Holland & Stroebel,1967; Startsman & Robinson,1972; Dlugacz, Siegel & Fischer,1982; Sultana,1990), this study showed a more positive attitude and better data completion by the non-medical staff. This may have been due to changing attitudes since the previous studies were conducted (Scarpa, Smeltzer & Jasion,1992; Rapko & Adaskin,1993), involvement of non-medical staff in the development of the programme or because of a structured implementation of the system in clinical areas (Zoltan-Ford & Chapanis,1987; Young, Chapman & Poile,1990; Whiteside, McCulloch & Whiteside,1990). The individual influence of any one of these factors is difficult to assess from the present study.

2.4.3 Conclusions

This study has shown that it is possible to combine a selection of well-validated multidisciplinary assessments into an integrated assessments system for monitoring recovery and outcome in stroke rehabilitation. A successful system, such as the OSMS, has a high level of acceptability amongst multiprofessional users and facilitates high quality data collection. Such systems have applications not only in patient care but also facilitate research (e.g. changes in abilities or outcomes after medical, therapy or service interventions, which can be further stratified according to deficits or prognosis) and provide information for commissioning and purchasing of stroke rehabilitation services.

CHAPTER 3. METHODS II: SETTING UP A STROKE REHABILITATION UNIT.

3.1 INTRODUCTION

Despite the decline in the incidence of stroke in recent years, the problem of stroke management is escalating because of the increase in the proportion of elderly and very elderly people in the population (Chapter 1). This has placed an important and increasing burden on the health services, particularly on the hospital sector (Bamford, Sandercock, Warlow & Gray,1986; Brommels, Tilvis & Autio,1987; OHE,1988; Persson, Silverberg, Lindgen et al.,1990; Smith,1990; Isard & Forbes,1992; Forbes,1993). In view of this, co-ordinated care of stroke patients is considered to be central to the issue of cost-effective management (Consensus Conference,1988) and recent years have seen the development of several models of care provision ranging from acute stroke units to enhanced home care for stroke (Russell, Hamilton & Tweedie,1993).

There is little evidence so far to suggest that acute stroke units, modelled on the lines of coronary care units, contribute significantly to recovery from stroke although they may, in common with non-acute stroke units, reduce mortality (Chapter 1). The emphasis, hence, needs to be on improving the prognosis of those patients who survive the immediate period of mortality by determining the most effective means of rehabilitation.

The logistics of providing for the needs of stroke survivors have been a subject of much debate (Rehabilitation Study Group,1972; Consensus Conference,1988). It is generally believed that acute medical departments (e.g. internal/cardiovascular medicine or neurology) with their emphasis on diagnostic investigation and "cure" of disease may be less equipped in terms of philosophy, training, staff or facilities to handle

the "care" problems inherent in the detailed planning required for rehabilitation of stroke patients (Garraway,1985). This has resulted in the development of integrated multidisciplinary teams and/or defined areas for stroke rehabilitation which are becoming increasingly accepted as feasible stroke management strategies (Consensus Conference,1988; Russell, Hamilton & Tweedie,1993).

3.2 COMPONENTS OF A STROKE REHABILITATION UNIT

If stroke rehabilitation units are evolving as the preferred management strategy for the future, it is important to define the components of these units to enable future comparisons when evaluating their effectiveness. Several definitions have been formulated in the seventies, of which the most favoured one appears to be "a team of specialists who are knowledgeable about the care of the stroke patient and are based on a special area of a hospital that provides beds for stroke patients (Bonner,1973)". Another definition which may be appropriate suggests that a stroke rehabilitation unit is "a geographic location within the hospital designated for stroke and stroke-like patients who are in need of rehabilitation services and the skilled professional care that such a (an) unit can provide (McCann & Culbertson,1976)."

Several disciplines have been suggested for inclusion in the team working on stroke rehabilitation units. Some recommendations include a large number of professions which may be neither be available nor feasible in most service settings (US Dept. of Health,1976; Feigenson & McCarthy,1977). Pragmatic criteria suggest that the minimum number of disciplines represented on a stroke unit should include a physician, nursing staff, physiotherapist, occupational therapist, speech therapist and a medical social worker (Care Manager), all of whom have important contributions to make to stroke rehabilitation (Garraway,1985).

It is essential that stroke units should have a collaborative policy for rehabilitation which should include identification and awareness of the objectives of

rehabilitation, comprehensive assessment of all aspects of patients' impairments and disabilities, close multidisciplinary liaison and an educational role for professionals and patients (Isaacs,1977). Professionals need to coordinate with each other and with the family to formulate and execute integrated rehabilitation plans taking into account problems and disabilities of individual patients (Garraway,1985). This is expected to involve frequent staff conferences with each member of the team participating in all activities of the stroke unit (Garraway,1985).

These principles were used as guidelines to set up the Orpington stroke rehabilitation unit. The unit and the philosophy of stroke care developed during its development were an important and integral part of subsequent studies undertaken as a part of this thesis (Chapters 4-9).

3.3 THE ORPINGTON STROKE REHABILITATION UNIT

3.3.1 Mission statement

The philosophy of the stroke service and the rehabilitation unit are to ensure that each stroke patient achieves his/her maximum potential and that the service given is regularly monitored to ensure that the best possible value is being obtained from the money and effort expended.

The stroke unit is dedicated to continuous development of effective stroke management through research and training. It will also be a central focus for multidisciplinary teaching in stroke rehabilitation.

3.3.2 Philosophy of care

1) There will be an agreed policy for the management of cerebrovascular disease, which will be updated at regular intervals.

2) Staff on the stroke rehabilitation and other units dealing with stroke patients will be specifically trained in stroke management.

3) Each patient will be carefully assessed according to an agreed protocol and the results recorded.

4) There will be a regular programme of activities for each patient which will avoid long periods of inactivity, particularly in the evenings and over weekends. The programme will be devised by the multidisciplinary team and administered by the nursing staff.

5) Spouses/carers will be actively involved in rehabilitation. This involvement will commence at the earliest appropriate opportunity and will be initially supervised.

6) Patients' progress will be regularly charted using agreed outcome standards.

7) Patients will not be kept in hospital unduly long and not be discharged prematurely.

8) Discharges will be planned in advance. Attempts at providing the appropriate level of support through various agencies will be undertaken. Patients will be monitored following discharge for an appropriate length of time.

9) Counselling support and stroke-related information will be provided to patients and their carers.

10) The unit will publish an annual report on the number of patients treated, mortality, length of stay and outcome at discharge.

3.3.3 History

The Orpington stroke rehabilitation unit was set up in December 1991 following the closure of 46 elderly care beds at Beckenham Hospital. The development was allowed by hospital management on the basis of a "zero-cost" initiative, requiring no new resource allocation. Additional benefits perceived by the management were:

1) A "positive" outcome of the much-opposed closure of Beckenham Hospital due to rationalisation processes in the district undertaken for "cost-improvement" as a part of the NHS Reforms.

2) Establishment of a specialist rehabilitation service in a key area using staff already employed, hence avoiding unwelcome deployment or expensive redundancies.

3) A public gesture of "good intentions" by the Bromley Health Authority in undertaking the first development of the proposed strategic plan for Orpington Hospital as a centre for rehabilitation following its closure as an acute hospital.

A 13-bedded unit was set up on a previously acute medical ward (Bodington) at Orpington Hospital. Admissions to the unit were initially limited to patients over 75 years of age reflecting existing patterns of service provision but the unit was later opened to stroke patients across all age groups. Despite the therapy intensive nature of stroke rehabilitation, no additional resources (over and above those of a standard geriatric ward) were committed to the unit either at its inception or when it was opened to patients of all ages.

3.3.4 Structure

The stroke rehabilitation unit is situated on the second floor in a modern block built in the 1980's. The accommodation of the unit consists of 4 bays, one of which has been converted into a physiotherapy area with appropriate equipment enabling stroke patients to be treated within the unit. There are 5 beds each in 2 bays, 2 beds in a smaller bay and 1 bed in a single room. All bays are spacious and well-lit with adequate space to manoeuvre wheelchairs around the beds. There are toilets and bath facilities at each end of the ward which have been adapted to be used by stroke patients. A single room on the ward has been designed as a pre-discharge room to assess functional independence prior to discharge in borderline patients. It has been fitted with an ordinary bed, room furniture and carpets to replicate conditions likely to exist at home. The ward has a kitchen for kitchen practice and assessment, a separate room for occupational therapy assessments, a quiet speech therapy area and an office. The Orpington Stroke Management System (Chapter 2) is based in this office, which also is used for administration and discussions with relatives and carers. Operational policies on medical and nursing management of stroke-related problems, lifting and handling techniques, management of continence, communication and swallowing, discharge planning, counseling of relatives and general issues are also kept in the office for reference purposes. The unit has a large day room which is used for group activities, meals and a meeting point for relatives. There is a general information stand in a prominent location which displays leaflets, books and newsletters on stroke and related issues circulated by the Stroke Association, Department of Health, Social Services and the Health Promotion Unit in Bromley. This stand is inspected and replenished on a regular basis.

3.3.5 Staffing

The staffing levels on the ward were determined by those available on one of the two geriatric medical wards closed prior to setting up the stroke unit.

Medical:

The medical input consists of 2 consultant sessions although these have not been funded. The day-to-day medical problems are addressed by a Senior House Officer shared with geriatric medicine and the young rehabilitation unit. This cover is available from 9am to 5 pm, Mondays to Fridays only. There is no resident medical staff in the hospital during nights and on weekends. Out-of-hours cover is provided by the medical registrar-on-call based at Bromley Hospital, about 6 miles away. Specialist neurological input (Dr C Clough) is available on a consultation-only basis. Surgical input for carotid endarterectomies is provided by Mr P Baskerville at King's College Hospital.

Patients on the unit have access to all investigation facilities as appropriate in their management. Specifically, there is unrestricted access to CT scanning, Doppler ultrasound sonography, echocardiography and angiography.

Nursing:

The nursing staff on the ward consists of 12.98 full time equivalents. The team is led by a ward manager and has an appropriate skill-mix. Although most of the nurses have rehabilitation backgrounds with experience in multidisciplinary working, none of the staff were specifically trained in stroke management initially. Since the inception of the unit, all staff have received multidisciplinary training incorporating specialist stroke nursing, basic medical aspects and handling of balance, mobility, perceptual, functional and emotional problems associated with stroke.

Therapy and other input:

The physiotherapy input available on the stroke unit consists of one Grade I Physiotherapist assisted by a basic grade therapist on rotation through the unit and a part-time physiotherapy aide. The occupational therapy is provided by 2 part-time Grade 1 Occupational Therapists (one full time equivalent) who are also assisted by a basic grade therapist on rotation and a therapy aide. Speech therapy input is available for 3 sessions per week, although there is an efficient "on-call" service for patients with swallowing problems. There are no difficulties in obtaining videoflouroscopy for patients with swallowing problems.

A full time care manager (medical social worker) funded by Bromley Social Services is attached to the unit. Input is also provided by the dietician and hospital support services.

3.3.6 Working Practices

Admission criteria:

The unit does not admit patients directly, but accepts referrals of stroke patients admitted to general medical and geriatric medical wards. Referrals are accepted for stroke patients no earlier than 1 week and no later than 4 weeks after stroke. Patients are assessed on the day of the referral by the consultant on the stroke unit (LK) or by a physiotherapist for suitability for specialist rehabilitation on criteria based on the Orpington Prognostic Score (Chapter 5 & 6). Patients scoring 3-5 on the score are normally considered to be suitable for transfer to the stroke unit. The criteria are, however, used as a guide with flexibility at both extremes of the scale. Patients who are outside the criteria may still be transferred to the stroke unit, if the assessor believes that the patient has problems which will benefit by stroke unit rehabilitation. The criteria for

admission to the stroke unit were instituted only after the completion of a randomised controlled study on stroke unit rehabilitation (Chapter 7), which showed advantages in patient selection for rehabilitation based on the Orpington Prognostic Score.

Patient Management:

Stroke patients admitted to the unit are assessed comprehensively at the time of transfer by multidisciplinary team members using a range of assessment as described previously (Chapter 2). Details of the home environment, previous functional status, expectations of rehabilitation outcome and possible post-discharge support available are discussed with patients and their families. The goals of rehabilitation are set by the team against which the patients' subsequent progress is measured. A plan of management, individualised to each patient's needs is then formulated and communicated to the various professionals involved in the patients' care, the patient and the family.

All patients are screened for risk factors in stroke (e.g. hypertension, smoking, cholesterol & blood lipids if under 60 years of age, diabetes mellitus & obesity) and treated or advised accordingly. The guidelines for secondary prevention of stroke requires that all patients are screened for atrial fibrillation, cardiac disease and carotid stenoses followed by medical or surgical intervention as appropriate. There are also protocols for prevention and treatment of secondary complications associated with stroke such as aspiration, chest infections, urinary retention or incontinence, urinary infections, deep vein thrombosis, pulmonary embolus, subluxation of the shoulder, pain, depression and epilepsy. Protocols for the management of problems such as dysphagia, spasticity, pressure areas and incontinence have been developed with multidisciplinary input.

The "named nurse" philosophy of nursing, whereby a designated nurse supported by the multidisciplinary team, is responsible for coordinating rehabilitation, discharge planning, advocacy and counselling is followed on the unit. There is close liaison between various disciplines with problems being addressed as they arise. Patients

on the unit have a single multidisciplinary assessment and progress record (Chapter 2), which is kept on the ward and is used by all professionals to communicate essential information. A formal multidisciplinary team ward round is undertaken every week in which patients' progress is reviewed against the goals set at the time of admission. Treatment goals or time schedules may be revised and the intensity or modality of treatment modified after discussion between team members. Potential discharges are planned in advance at this meeting. In addition, informal meetings between the therapists, nurses and the Care Manager are held frequently to discuss more immediate management issues.

Spouses and relatives are encouraged to participate in the rehabilitation process. A booklet is given to all relatives at the time of admission giving information on what to expect from the stroke unit, the type of work undertaken by different disciplines and the rehabilitation process in general, as well as their contribution to the process. The booklet also contains information on help available and various voluntary agencies which deal with stroke patients. In patients likely to require help from spouse or families after discharge, carers are encouraged to attend training sessions with the nurses and the therapists to ease the burden of care following discharge.

Discharge Planning:

Discharges on the unit are planned well in advance. In patients who have severe disabilities or in whom a difficult home situation is anticipated, the occupational therapist and the care manager jointly undertaken an "access" visit in the early stages of rehabilitation to estimate the abilities, adaptations and services required for a successful discharge. This may lead to a revision of rehabilitation goals with the emphasis of treatment being geared towards enabling optimal functioning within the home environment given the patient's disabilities. In other stroke patients, a multidisciplinary home visit with the patient is undertaken nearer to the achievement of rehabilitation goals to assess the need for minor adjustments in the rehabilitation programme, adaptations at

home or service requirements following discharge.

All discharges from the stroke unit are monitored for 3 months by the Care Manager. Follow-up visits are undertaken by the relevant therapists if there are unresolved problems or concerns about being able to manage in the home environment. Most stroke patients discharged from the unit continue to attend outpatient rehabilitation in the general rehabilitation department as appropriate to their needs.

3.3.7 Training Aspects

Education of members of the multidisciplinary team has always been considered to be an important aspect of stroke management. Initial training of staff working on the unit was achieved by intensive multidisciplinary sessions involving both theoretical as well as practical instruction by specialists in relevant areas. Continuing education is provided by weekly tutorials arranged by the ward manager in which specialist aspects of stroke management are reviewed and discussed by members of the multidisciplinary team. The constant evaluation of stroke practice with regular multidisciplinary audit has been helpful in improving patient care on the unit. Besides a regular cycle of audit, members of the multidisciplinary team are encouraged to investigate areas of particular interest and share their findings with other members of the team. These practices have resulted in a number of changes in way stroke patients are managed on the unit and clinical practice has continued to evolve with time.

The establishment of the stroke unit has raised stroke awareness on other wards in the hospital which has resulted in initiatives for multidisciplinary stroke management protocols on wards other than the stroke unit. There is a perceived need for basic training in handling acute stroke patients on general wards which should help to reduce stroke-related morbidity and improve eventual outcome. The unit is actively involved in designing and providing stroke management courses on a regular basis, not only for hospital staff but also for professionals and carers in the community. It is envisaged that this will result in better overall management of stroke and reduce

long-term disability in the community.

3.4 BENEFITS AND EVALUATION

Evidence from the literature suggests that better organisation of stroke rehabilitation such as that on stroke rehabilitation units will result in better outcome in stroke patients (Chapter 1). Besides organisation, the psychological and therapeutic effects of stroke unit rehabilitation may contribute to better outcome (Garraway,1985). A ward routine geared down to the capacity of stroke patients together with the encouragement and competitive stimulus of good treatment may be an important contributory factor in recovery. The close relationship between hospital staff and patients (the concept of a therapeutic community in rehabilitation) may also have profound effects in maintaining the rehabilitation gains produced by intensive treatment input (Abramson, Kuttner, Rosenberg et al.,1963). Finally, the effect of creating an atmosphere of stroke awareness, not only in the hospital but also in the community and the removal of the artificial separation between the hospital and home interface on such units cannot be ignored (Borhani,1974).

The Orpington stroke rehabilitation unit fulfils the definition and has the minimum suggested disciplines, staff and facilities required for a stroke rehabilitation unit. Informal observations on the stroke unit suggests that multidisciplinary philosophy and functioning are well-established on the unit and should provide optimal conditions for stroke rehabilitation. However, it cannot be presumed that the mere existence of such a unit will automatically improve stroke rehabilitation, especially since previous studies on the effectiveness of stroke units have shown equivocal results (Chapter 1). Whether the Orpington stroke unit lives up to its promise and the various aspects of its functioning have been investigated in carefully designed and controlled studies which are presented in subsequent chapters of the thesis (Chapters 7-9).

CHAPTER 4. ADVANCED AGE AND STROKE: APPLICABILITY OF PROGNOSTIC MEASURES.

4.1 INTRODUCTION

Stroke is mainly an illness of advancing years with the incidence of stroke rising from 0.2/1000/year in patients aged 45-54 years to nearly 10/1000/year in patients aged 85 years or more (Oxfordshire Community Stroke Project,1983; Bamford, Sandercock, Dennis & Warlow,1988; Royal College of Physicians,1989). The incidence of hospitalisation in elderly stroke patients is high, mainly for rehabilitative, nursing and social needs rather than for medical intervention (Wade & Langton-Hewer,1985a; Bamford, Sandercock, Warlow & Gray,1986). It is estimated that approximately 41% of stroke patients are managed on geriatric wards and occupy nearly 21% of beds in the speciality (Wade & Wood,1985; OHE,1988). Hospital costs of stroke management are likely to escalate in future because of a 40% predicted increase in incidence and the increased requirement of care in the acute phase (Malmgren, Bamford, Warlow et al.,1989). An increasing proportion of these costs will be incurred in older stroke patients because of the predicted increase in the elderly population, higher incidence of stroke in this age group and increasing frailty and social isolation of very old stroke patients resulting in hospitalisation. Despite these considerations, little is known about stroke in patients of more advanced age.

There have been many studies on the natural history of stroke from which several prognostic indicators have been derived (Britton, De Faire, Helmers et al.,1980; Prescott, Garraway & Akhtar,1982; Wade, Skilbeck & Langton-Hewer,1983; Allen,1984; Shah, Barer & Mitchell,1989; Vanclay & Cooper,1989,1991; Wade 1993). Most of these studies, however, have been limited to relatively young stroke patients.

Little is known about factors which affect stroke outcome in older patients, many of whom may have additional disability and, hence, poorer prognosis (Carstairs,1976). As no previous studies have been limited exclusively to elderly stroke patients despite their numbers, a study of stroke patients aged over 75 years was undertaken to identify features which determine outcome in this age group.

4.2 METHODS

This one year prospective study was conducted in stroke patients over 75 years of age from a well-defined geographical area (estimated population >75 years 7400) (Bromley Health Authority,1990) admitted to a unit operating a 24-hour, age-related, acute admissions policy. The patch included the mainly suburban areas of Penge, Anerley, Beckenham, West Wickham and Hayes, all of which have an above average elderly population. The Standardised Mortality Ratio in this patch was 95.6, and 5-7% of the elderly population were below the Jarman Eight Index (Bromley Health Authority,1990). During the 1 year period of the study, 97% of all patients over 75 years of age requiring hospital treatment were admitted to the unit (Bromley Health Authority,1990).

Stroke was defined as acute onset of neurological deficit lasting more than 24 hours or leading to death, with no apparent cause other than cerebrovascular disease (WHO,1989). The diagnosis of stroke was based mainly on history and clinical examination. Computerised tomography (CT) scanning of stroke patients was not undertaken routinely because universal CT scanning of stroke patients is neither available (Langton-Hewer & Wood,1989) nor, to date, considered necessary for diagnosis (Sandercock, Molyneaux & Warlow,1985; Sotaniemi, Phytinen & Myllyla,1990; Ricci, Celani, LaRosa et al.,1991; Wade,1992a). CT scanning, however, was undertaken when the diagnosis was in doubt or when further surgical or medical intervention was being considered.

Details of age, gender, social circumstances, pre-stroke Barthel scores (Wade & Collin,1988), previous strokes, other medical problems and dementia were recorded. A detailed assessment within 72 hours of admission included level of consciousness (motor subscale of the Glasgow Coma Scale, Table 4.1) (Wade,1986), side of stroke, subjective awareness of deficit (determined clinically by verbal or non-verbal response to the question "Is there something wrong with the right/left side of your body?"), power in the arm and leg on the affected side [Medical Research Council grading (Macleod,1983), Table 4.1], incoordination, hemianopia, dysphasia, dysphagia, sensory deficits, inattention (visual/sensory), continence, abbreviated mental test score (MTS) (Qureshi & Hodkinson,1974, Table 4.1), mobility (Holden, Gill, Maggliozzi et al,1984), and Barthel ADL index. The MTS is a well-validated test and consists of 10 items assessing memory and orientation (Jitanpunkul, Pillay & Ebrahim,1991). The test is conducted on the ward with the patient responding verbally to questions asked by the observer. In the presence of dysphasia, responses were by speech or signs to spoken or written answers suggested by the observer. These assessments were repeated at weekly intervals until the conclusion of the study. The end points of the study were defined as: death, discharge home, placement in institutional care or hospital stay exceeding 24 weeks.

Stroke management was undertaken on mixed wards with stroke and non-stroke patients. Therapist cover included 1 full-time physiotherapist and 1 part-time occupational therapist (supported by 1 assistant each) per 2 wards of 20 beds. All stroke patients received physiotherapy and occupational therapy as appropriate for their disability. In addition, there was regular input from speech therapists, social workers and the patient placement officer.

Descriptive statistics have been used in data presentation and multiple regression analysis (stepwise deletion) was used to determine the effects of assessment variables on eventual outcome. The regression coefficient (B) and the probability value (p) of significant independent variables influencing outcome have been described where appropriate.

Table 4.1 Brief description of initial assessments used in older stroke patients.

Response	Score
A) Glasgow Coma Scale (Motor response)	
None to pain, limbs remain flaccid	1
"Decerebrate" extension	2
"Decorticate" flexion	3
Withdrawal from pain	4
Localises pain with attempts to remove	5
Follows simple commands	6
B) Medical Research Council grading for power	
Greatest power in the extensors of affected limb:	
normal power	5
diminished power	4
movement against gravity	3
movement with gravity eliminated	2
flicker when attempting movement	1
no movement	0
C) Abbreviated Mental Test score	
Score one point for each question answered correctly:	
1) Age of the patient	1
2) Time (to nearest hour)	1
3) Address given, for recall at the end of the test: 42, West Street.	1
4) Name of Hospital	1
5) Year	1
6) Date of birth of patient	1
7) Month	1
8) Years of First World War	1
9) Name of Monarch	1
10) Count backwards from 20-1	1

4.3 RESULTS

Stroke was diagnosed in 102 patients and accounted for 9.7% (102/1056) of the total medical admissions in patients over 75 years of age from the defined population representing a third of the district. Six patients were excluded because of non-cerebrovascular disease on CT scans.

4.3.1 Demographic data

The mean age of the 96 patients (M:F ratio= 28:72) included in the study was 81.3±5.4 years. Previous strokes were seen in 18 (18.8%) patients, 13 (72%) on the same side and 5 (28%) on the opposite side to the present stroke. The majority of patients (n=74) were independent (except for some patients needing help with stairs or bathing) in personal Activities of Daily Living prior to stroke and lived alone (n=58). Fifteen patients (living alone=9) required assistance for mobility and self care (Barthel index: median 12; mean 11.9±2.2) and 7 patients were admitted from long-term institutions (Barthel index: median 6; mean 8.1±3.6). Dementia, diagnosed prior to the present admission, was present in 22 (23%) patients, 5 of whom were admitted from long-term care.

4.3.2 Initial assessment

The consciousness level of patients ranged from 1-6 (median: 3; mean 4.2±2.6) at the time of admission. Ten patients remained deeply comatose or died within 72 hours of admission and could not be assessed. In the remaining 86 patients, left hemiplegia was seen in 48%, right hemiplegia in 44% and brainstem/cerebellar signs in 8% patients (Table 4.2). Power in the affected arm varied from 0 to 4 in the affected leg and sensory loss was present in 12.5% patients. There was a significant prevalence of hemianopia, dysphasia, dysphagia, and sensory/visual inattention in these patients (Table 4.2). Incontinence was seen in 68 (79%) patients and 32 patients (28 with left hemiparesis) were subjectively unaware of the neurological deficit. Median Barthel index at the time of admission was 3 (mean 3.4±2.6) in the 86 patients assessed.

Table 4.2 Initial stroke assessment undertaken in 86* stroke patients aged over 75 years within 72 hours of acute admission to hospital.

Clinical features	
Left hemiplegia	41 (47.6%)
Right hemiplegia	38 (44.2%)
Brainstem/cerebellar	7 (8.2%)
Mean level of conciousness**	4.2±2.6 (GCS)
Mean power in affected arm (triceps)	2.4±1.5 (MRC scale)
Mean power in affected leg (quadriceps)	3.1±1.3 (MRC scale)
Sensory Loss	11 (12.5%)
Hemianopia	34 (39.5%)
Sensory/visual inattention	46 (53.4%)
Dysphasia	17
Dysphagia	17 (19.7%)
Urinary incontinence	68 (79%)
median Barthel ADL index	3 (Max. 20)

*n=86 because 10 patients were too ill to be assessed comprehensively within 72 hours of admission.

** Assessed at the time of admission.

GCS: Glasgow Coma Scale
MRC: Medical Research Council
ADL: Activities of daily living

4.3.3 Mortality

Thirty-two patients (33%) died during the study (median survival 11 days). The majority of the deaths were within the first two weeks of admission, with 8 deaths within 72 hours, 15 within 7 days and 23 within 14 days of admission. Early death correlated with the level of consciousness, severity of neurological deficit, dysphagia and pre-stroke Barthel index (Table 4.3) on initial assessment at the time of admission. Age, gender, previous strokes, other medical problems or cognitive impairment prior to admission did not influence early mortality.

Nine patients died during rehabilitation, their median survival being 72 days. The cause of death was a second stroke in 5 patients (same side=4; opposite side=1), chest infection in 3 patients and acute myocardial infarct in 1 patient.

4.3.4 Rehabilitation outcome

Of the 64 survivors, 52 (80%) patients were discharged home (median length of hospital stay 69 days). Seventeen patients (32.7%) were discharged within 3 weeks of admission. A complete resolution of neurological deficit was seen in 9 patients. Neurological deficit improved considerably in other subjects, with improvements in power (pre-discharge mean 4.2 ± 0.8), mobility (pre-discharge median: 4) and functional ability (pre-discharge median Barthel 17 [mean 17.7 ± 2.3]). These patients were able to cope with little or no additional help (shopping, cleaning) from family or services. Factors that influenced early discharge included right rather than left sided stroke, good motor power, unimpaired consciousness on admission, and absence of sensory deficit/inattention or incontinence during initial assessment (Table 4.3). Early recovery was not influenced by age, gender, previous strokes or pre-stroke Barthel index (Multiple regression analysis).

The median duration of stay of the 35 other patients eventually discharged home was 92 days. Twenty three (66%) were independently mobile with or without aids

(mobility level 4-5), 8 (23%) were wheelchair independent and 4 patients required help with mobility and transfers (mobility level 2-3). The median Barthel index at the time of discharge was 13 (mean 14.3±2.4). All patients required additional social services support following discharge, a high input (personal care/home care) being required in 14 (40%) patients. Ten (29%) patients required further outpatient rehabilitation following discharge.

Twelve patients were transferred to nursing or residential homes (median duration of hospital stay 164 days). Of these, 3 had been discharged home previously with adequate support following a pre-discharge assessment at home. The functional ability of these patients was unchanged but long-term care was necessary because of social pressure.

In patients requiring longer rehabilitation, assessment of physical or functional abilities (eg age, gender, side of stroke, previous strokes, functional status prior to admission, other medical illness, severity of neurological deficit, consciousness levels, mental test scores, mobility and Barthel ADL index) at the time of admission did not relate to the discharge destination. A further assessment at 2 weeks was more predictive of discharge home, showing an increased probability of requiring long-term care in patients with low MTS scores, poor awareness of deficit, hemianopia/inattention, sensory deficit/inattention and incontinence (Table 4.3). Stroke survivors with Barthel index <6 and MTS<4 at 2 weeks failed to improve significantly and required long-term nursing care.

Table 4.3 Clinical features which significantly influence stroke outcome in patients aged over 75 years identified using multiple regression analysis (stepwise deletion).

Outcome	Discriminants	R^2	B	p
Mortality (n=23)		54.2%		
	level of conciousness		-0.114	0.021
	severity of deficit		-0.058	0.008
	dysphagia		0.005	0.044
	pre-stroke Barthel score		0.014	0.037
Early discharge (n=17)		71.6%		
	right stroke		0.04	0.016
	motor power		0.0103	0.002
	conciousness level		0.052	0.047
	sensory deficit/inattention		-0.034	0.002
	incontinence		-0.026	0.008
Poor outcome (n=47)*		64.2%		
	cognitive impairment		0.016	0.032
	awareness of deficit		-0.019	0.021
	motor weakness		-0.094	0.007
	hemianopia/inattention		0.002	0.03
	sensory deficit/inattention		0.007	0.008
	incontinence		0.031	0.019

R^2= coefficient of determination ; B= regression coefficient; p= significance

* Clinical features at 2 weeks used in multiple regression analysis for poor outcome (cf Mortality and early discharge where clinical features at initial assessment were significant).

4.4 DISCUSSION

Measurement of outcome of stroke rehabilitation in district populations is difficult because of the heterogeneity of patient population and the variety of settings in which stroke is treated. Although the costs of stroke management are expected to increase in parallel with the contemporary rise in the elderly population, much previous work has tended to exclude patients of advanced age.

The difficulties of reliable clinical data collection in patients of advanced age are well-known and underlie the relatively small number of patients (n=96) included in the present study. Despite this, the results can be considered representative of stroke outcome in hospitalised older patients in suburban areas of southeast England because the study was conducted in a well-defined elderly population with no significant cross-boundary flows or referrals to other departments (Bromley Health Authority,1990).

The results show that 33% of hospitalised older stroke patients died, 54% returned home and 13% were transferred to institutional care. The number of patients returning home was higher than reported on general wards and comparable to that on stroke rehabilitation units (Wade, Wood & Langton-Hewer,1985; Hamrin,1982a; Stevens, Ambler & Warren,1984; Garraway, Akhtar, Prescott & Hockey,1980, Friedman, 1990).

Several factors may have contributed to this observation. Poor outcome on general wards has been attributed to misunderstanding and rivalries between professionals, breakdown of communication and ill-prepared or unplanned discharges (Consensus Conference,1988). These problems may be less likely on established wards in departments of geriatric medicine, where the multidisciplinary team approach to patient care, consultation with carers and planned discharges are normal practice. Not surprisingly, a recent study has failed to show any difference in outcome between specialist units and such wards (Edmans & Towle,1990). It also may have been possible to discharge patients with higher levels of disability, firstly because of lower expectations of well-being amongst older people and, secondly, because of the

community support systems developed during the last two decades. Finally, it is possible that therapy resources and skills may have been diverted from general wards to stroke rehabilitation units during previous studies, with adverse effects on staff motivation and rehabilitation practice, resulting in poorer outcome.

The median length of hospital stay for survivors in the present study (69 days) was greater than that of 29-55 days reported elsewhere (Wade, Wood & Langton Hewer,1985, Garraway, Akhtar, Prescott & Hockey,1980, Friedman,1990). It is possible that age (mean 81 years in this study compared with <75 years in other studies), other medical or locomotor problems and sensory or cognitive impairment may have contributed to slower recovery. On the other hand, a longer hospital stay may have been the result of poorly coordinated and improperly targeted therapy (Consensus Conference,1988). There is some evidence that patients managed on special units recover more quickly and there may be savings on hospital bed occupancy (Friedman,1990; Langton-Hewer,1990).

It is possible that the cost-effectiveness of stroke rehabilitation could be improved by appropriate patient selection (Young,1988). Specialist units would be of little advantage in patients who would do well or those who would do badly whatever the therapy input. Stroke survivors with low Barthel and MTS scores in the absence of an acute illness 2 weeks after admission appear to have limited rehabilitation potential and alternative management strategies may be more appropriate. The prospects of discharge home (with or without support) are also poor in patients who continue to have severe motor deficit, sensory/perceptual problems, cognitive impairment and incontinence. However, the early and reliable identification of such patients and those most likely to benefit from intensive rehabilitation has presented problems (Langton-Hewer,1990; Osberg, Haley, McGinnis & DeJong,1990).

The clinical determinants which significantly influenced the short-term prognosis and outcome of stroke rehabilitation in this group of older patients are in general agreement with those seen in studies in relatively younger patients (Prescott, Garraway & Akhtar,1982; Allen,1984; Anderson,1990; Shah, Vanclay & Cooper,1991;

Benedetti, Benedetti, Stenta et al. 1993; Censori, Camerlingo, Casto et al.,1993; Wade, 1993). The only exception was dementia, which significantly influenced outcome in older stroke patients. Prognostic scores based on clinical determinants have been suggested for younger stroke patients (Prescott, Garraway & Akhtar,1982). The similarity in clinical determinants of stroke rehabilitation outcome in those of more advanced age suggests that it may be possible to apply such scores (with appropriate modifications) in older patients to help target scarce therapy resources to those most likely to benefit from intensive input.

CHAPTER 5. DEVELOPMENT OF A CLINICAL PROGNOSTIC SCORE AIMED AT TARGETING STROKE REHABILITATION.

5.1 INTRODUCTION

The objective of stroke rehabilitation is to ensure that patients achieve their maximum potential and that the best possible value is being obtained from the money and effort expended (Langton-Hewer,1990). The issues of costs and benefits of stroke management have always been important in insurance-based health care systems, but are now becoming increasingly important in the British National Health Service (Enthoven,1985). In the present climate of limited health-care resources cost-effective stroke rehabilitation for elderly people may depend upon strategies which can target intensive treatment, such as that offered in specialist areas, towards patients most likely to benefit from such input.

Expected prognosis based on clinical determinants could be used to target stroke unit resources more appropriately by identifying the patients most likely and those least likely (with mild or very severe disability) to benefit from intensive rehabilitation (Young,1988). The study in stroke patients over 75 years of age (Chapter 4), has shown that besides known determinants of prognosis (Prescott,Garraway & Akhtar,1982; Allen,1984, Barer & Mitchell,1989, Anderson,1990; Shah, Vanclay & Cooper,1991), outcome in elderly patients is significantly influenced by cognitive impairment. The influence of cognitive impairment on rehabilitation in the elderly has also been described elsewhere (Isaacs & Marks,1973; Carstairs,1976; Ebrahim, Nouri & Barer,1985; Friedman,1990).

A number of studies have tried to describe patients who may show the greatest improvement in function and independence following stroke rehabilitation (Feigenson, McDowell, Meese et al.,1977; Wade, Langton-Hewer, Wood et al.,1983; Jongbloed,1986). Several prognostic scores based on clinical indicators also have been developed for use in relatively young stroke patients (Britton, DeFaire, Helmers et al.,1980; Prescott, Garraway & Akhtar,1982; Allen,1984; Shah, Vanclay & Cooper,1989; Gladman, Harwood & Barer,1992). Despite the fact that rehabilitation programmes and, hence, prognosis are significantly influenced by the patients' ability to learn new techniques, none of the commonly used prognostic scales include any measures of cognitive function.

The Edinburgh Prognostic Score (Prescott, Garraway & Akhtar,1982) is one of the scores recommended for use in older patients (Young,1988). The Edinburgh Prognostic Score was derived from discriminant analysis of several clinical features of stroke patients in the Edinburgh study (Prescott, Garraway & Akhtar,1982). Three of these were found to correlate with dependency levels at discharge or at the 16 week cut-off point (Table 5.1). Possible scores range from 1.6 (best prognosis) to 5.6 (worst prognosis). Although included in the multiple regression analysis, cognitive impairment was not found to be a significant discriminant in this patient group. This is not surprising because the mean age of patients in this study was 73 years and significant levels of background cognitive impairment were unlikely to be present in this patient group. The applicability of the Edinburgh score to patients of more advanced years, many of whom may have cognitive impairment, remains open to question.

It may have been possible to develop a multivariate score from the data available, but in view of the multiplicity of assessment scales already in use in stroke rehabilitation (Chapter 1), it was decided to modify a pre-existing and validated scale (Edinburgh Prognostic Score) to include cognition as an additional discriminant. The discriminants in the new score (Orpington Score) were given the same weighting as the Edinburgh Score, although this may not have been reflected in the Orpington population. The validity of the modified score (Orpington Score), hence, was assessed in the study group.

Table 5.1 The Edinburgh Prognostic Score (after Prescott et al, 1982)

Clinical Features	Score
Motor deficit in arm	
MRC grade 5	0
MRC grade 4	0.4
MRC grade 3	0.8
MRC grade 1-2	1.2
MRC grade 0	1.6
Proprioception (eyes closed)	
locates affected thumb:	
accurately	0
slight difficulty	0.4
finds thumb via arm	0.8
unable to find thumb	1.2
Balance	
walks 10 feet without help	0
maintains standing position	0.4
maintains sitting position	0.8
no sitting balance	1.2
Total score = 1.6 + motor + proprioception + balance	

MRC: Medical Research Council grading for power

5.2 METHOD

This study was conducted in 64 stroke survivors from the 96 patients over 75 years described previously (Chapter 4). The definition of stroke, method of diagnosis and inclusion have been described previously (Chapter 4). Patients with Alzheimer's disease or multi-infarct dementia were included in the study since these conditions frequently complicate stroke in this age group. No attempts were made to classify dementia into multi-infarct or Alzheimer's type because of difficulties in accurately differentiating between the two conditions and the fact that they frequently co-exist in older patients. It was presumed that both groups would be equally disadvantaged because of diminished learning abilities secondary to dementia.

The Edinburgh Prognostic Score (Table 5.1) was calculated at 1, 2 and 4 weeks post-stroke in all patients included in the study. As cognitive impairment, in addition to measures of motor deficit, proprioception and balance used in the Edinburgh Score, is an important determinant of outcome, the Edinburgh Score was modified to include a widely-used measure of cognitive dysfunction (Abbreviated Mental Test Score). This modified version was called the Orpington Score (Table 5.2) and ranged from 1.6 (best prognosis) to 6.8 (worst prognosis). The methodology of applying the Orpington Prognostic Score is described in Appendix II. In addition to the Edinburgh Prognostic Score, Orpington scores and Barthel index were recorded at 1, 2 and 4 weeks in these patients.

Stroke management was undertaken as previously described (Chapter 4). Patients were objectively assessed for neurological deficit, cognitive function, continence, mobility and activities of daily living by the multidisciplinary team at weekly intervals. Professionals involved in the assessment and day to day management of these patients were unaware of their prognostic scores or expected outcome.

The correlation of Edinburgh and Orpington prognostic scores and Barthel ADL index at 1, 2 and 4 weeks to Barthel ADL index at discharge or at 16 weeks (if still hospitalised) for the survivors was assessed using linear regression. The ability of these scores to prognosticate outcome was also assessed.

Table 5.2 The modified Edinburgh Prognostic Score (Orpington Score).

Clinical Features	Score
Motor deficit in arm	
MRC grade 5	0
MRC grade 4	0.4
MRC grade 3	0.8
MRC grade 1-2	1.2
MRC grade 0	1.6
Proprioception (eyes closed)	
locates affected thumb:	
accurately	0
slight difficulty*	0.4
finds thumb via arm	0.8
unable to find thumb	1.2
Balance	
walks 10 feet without help	0
maintains standing position	0.4
maintains sitting position	0.8
no sitting balance	1.2
Cognition	
Mental Test Score 10	0
Mental Test Score 8-9	0.4
Mental Test Score 5-7	0.8
Mental Test Score 0-4	1.2
Total score = 1.6 + motor + proprioception + balance + cognition	

MRC: Medical Research Council grading for power

Please refer to Appendix II for methodology of scoring.

5.3 RESULTS

Of the 64 stroke survivors over 75 years of age, 52 (80%) were discharged home and 12 patients were transferred to nursing or residential homes (Chapter 4).

Seventeen patients (32.7% of patients returning home) were discharged within 3 weeks of admission. Their median Barthel ADL index was 6 (Range 2-8) at the time of admission and 17 (Range 14-20) at the time of discharge. None of these patients had evidence of significant cognitive impairment (MTS 8-10). The Edinburgh Prognostic Score (range 2.0-3.6) and the Orpington Prognostic Score (range 2.0-3.6) measured at 1 week in these patients showed a significant ($p<0.001$) and comparable ($r^2=0.9$ v $r^2=0.9$) correlation with Barthel ADL index at discharge. Prognostic scores could not be measured at 2 weeks in 11 patients because they had been discharged from hospital. A significant correlation was also seen between admission Barthel ADL index and discharge Barthel ADL index in this group ($r^2=0.64$, $p<0.001$).

Thirty-five of the remaining 47 patients were eventually discharged home. These patients had a median Barthel ADL index of 3 (Range 0 - 6) on admission. Their Orpington Score was 4.0 to 6.4 at 1 week and 3.2 to 4.8 at 2 weeks after the acute episode. The median Barthel index at the time of discharge was 13 (Range 8-17). The median Barthel ADL index of 12 patients who required long-term care was 2 (0-4) at the time of admission. Their Orpington score ranged from 5.6 to 6.8 at 1 week and 5.2 to 6.8 at 2 weeks. Recovery was very limited in these patients and they had median Barthel ADL index of 4 (Range 0-8) at the time of transfer to long-term care facilities.

Linear regression showed significant correlation between the Edinburgh Prognostic Score measured at 2 weeks and ADL index at discharge or 16 weeks ($r^2=0.57$, $p<0.001$) (Fig 5.1) for the whole patient group (n=64). The correlation was stronger in cognitively intact (MTS 8-10) patients (n=27, $r^2=0.91$, $p<0.001$) (Fig 5.2) compared to patients with MTS less than 7 (n=37, $r^2=0.39$, $p<0.05$) (Fig 5.3). A stronger correlation was seen between the modified Edinburgh Prognostic Score (Orpington Prognostic

Score) measured at 2 weeks and Barthel ADL index at discharge or 16 weeks (r^2=0.89, $p<0.001$) for all patients (n=64) (Fig 5.1). In contrast to Edinburgh Prognostic Score, the predictive value of Orpington Prognostic Score did not diminish in the presence of dementia (n=37, r^2=0.81, $p<0.001$) (Fig 5.3). Barthel ADL index on admission showed a significant but weak correlation with Barthel ADL index at discharge (r^2=0.24; $p<0.01$) for the whole patient group. Although Barthel ADL index at 2 weeks was more predictive of outcome (r^2=0.58; $p<0.001$), its predictive value was less than that of Orpington Prognostic Score at 2 weeks.

Edinburgh Prognostic Score or Orpington Prognostic Score measured one week after the initial event did not correlate significantly with Barthel ADL index at discharge or 16 weeks in patients hospitalised for more than 3 weeks. The correlation of prognostic scores measured at 4 weeks with Barthel ADL index at discharge or 16 weeks was similar to that of prognostic scores measured at 2 weeks for both Edinburgh and Orpington scores.

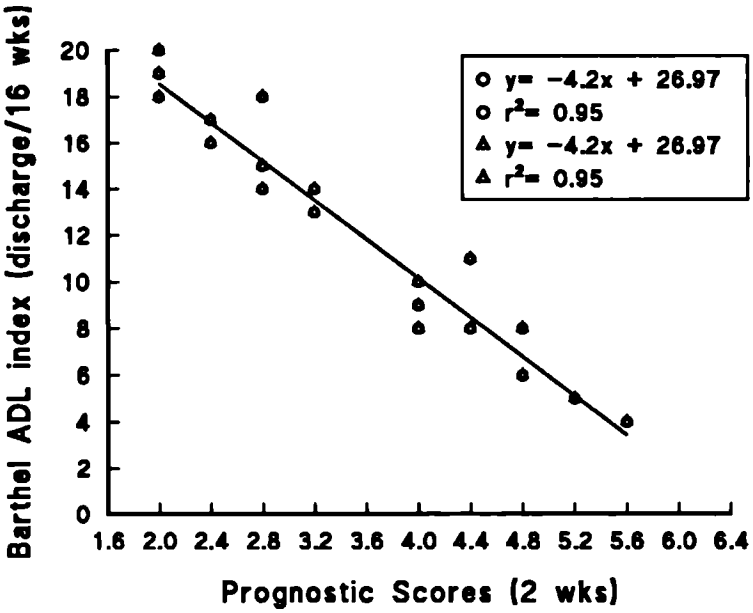


Fig 5.1 Relationship between ADL index at discharge/16 weeks and Edinburgh (▲) and Orpington (o) prognostic scores at 2 weeks in 27 elderly stroke subjects with no cognitive impairment.

(—— Orpington score ----- Edinburgh Score)

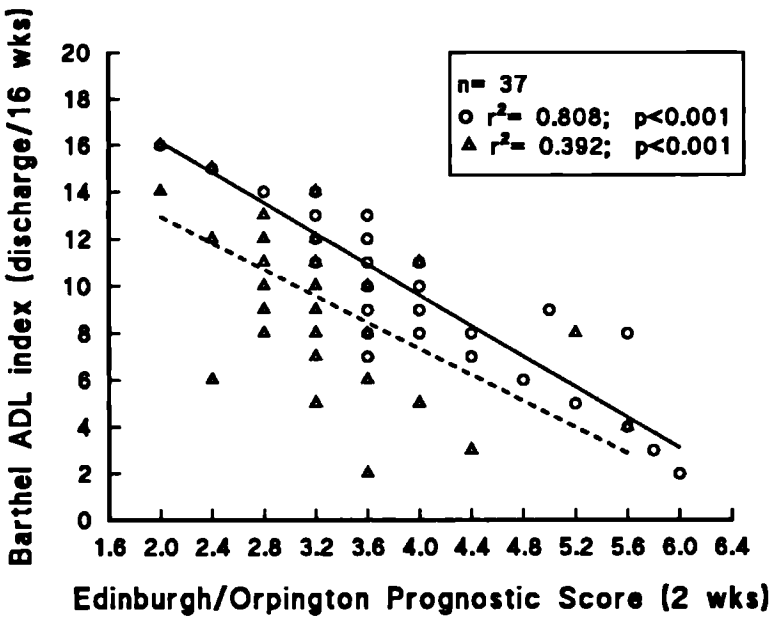


Fig 5.2 Relationship between ADL index at discharge/16 wk and Edinburgh (▲) and Orpington score (o) measured at 2 weeks in elderly stroke patients with cognitive impairment.

(—— Orpington score ----- Edinburgh Score)

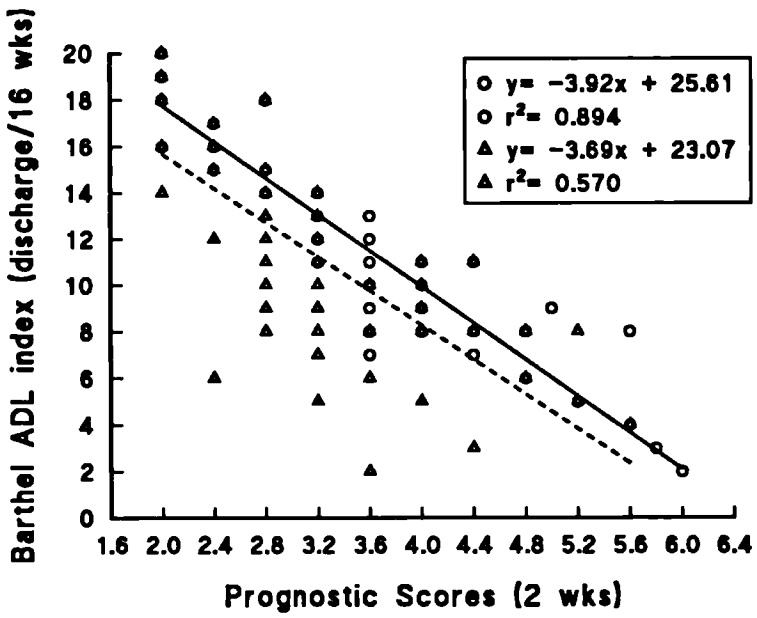


Fig 5.3 Relationship between ADL index at discharge/16 wk and Edinburgh (▲) and Orpington (o) prognostic scores at 2 weeks in 64 elderly stroke subjects.
(—— Orpington score ----- Edinburgh Score)

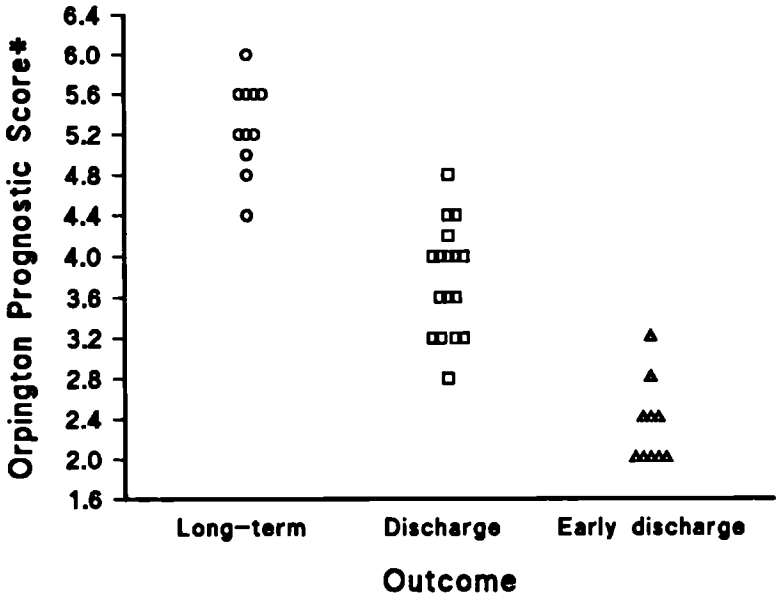


Fig 5.4 The distribution of Orpington Prognostic Scores in elderly stroke patients requiring long-term care (n=12), discharged after rehabilitation (n=35) or discharged within 3 weeks of admission (n=17).

5.4 DISCUSSION

Predicting the outcome of mild or very severe strokes is usually straightforward (Chapter 1), and should not present rehabilitation dilemmas. It is more difficult to predict outcome or rehabilitation needs in patients with moderately severe deficits in whom the possibility of discharge home or degree of functional recovery is uncertain on initial assessment. Prognostication in this group of patients can be facilitated by incorporating major determinants of outcome into a well-defined set of simple but objective clinical criteria. The Edinburgh Prognostic Score has been recommended for use in older patients because it incorporates measures of power, balance and proprioception which have been shown to be significant predictors of stroke outcome in other studies (Sandin & Smith,1990; Goldie, Matyas, Spencer & McGinley,1990; Lincoln,1992; Wade,1993a). The predictive value of the Edinburgh Prognostic Score in older stroke patients, however, was limited principally because it did not include a measure of cognitive impairment. The Orpington Score which incorporates a measure of cognition based on a commonly-used, robust and simple mental state examination (Jitapunkul, Pillay & Ebrahim,1991) showed better overall correlation with functional outcome (r^2=0.89 v 0.57), especially in patients with cognitive impairment (r^2=0.81 v 0.39). A correlation between Barthel index at admission and discharge has been reported elsewhere (Shah, Vanclay & Cooper,1989) and was also seen in this study. The correlation of Barthel index at 2 weeks to functional ability at discharge was similar to that observed for Edinburgh score but was weaker than that seen for Orpington scores (r^2=0.58 v 0.89).

Stroke patients discharged early had mild to moderate neurological deficit and were characterised by Orpington scores of less than 3.2 (Fig 5.4). It is unlikely that these patients would have benefitted from stroke unit rehabilitation over and above that routinely available on general wards. The largest group of stroke patients, however, consisted of those with moderately severe deficits who scored between 3-5 on the Orpington scale. This group probably represented patients most likely to need, and benefit from, stroke unit rehabilitation.

Patients with an Orpington score >5.2 had very severe neurological deficits and required long-term nursing care (Fig 5.4). It would appear that this group of patients was least likely to benefit significantly from stroke unit rehabilitation. This does not mean that all therapy support should be withdrawn from very severely disabled patients, especially as minor changes in ability may improve quality of life significantly. Rehabilitation on a stroke unit in patients with poor prognostic expectations, however, may cause considerable distress to the patient and their family and also result in inappropriate use of hospital resources (Wade, Wood & Langton-Hewer,1985).

The timing of any assessment for stroke unit rehabilitation is important. Prognostic scores measured at 1 week may predict outcome in patients likely to be discharged early but are not predictive for patients requiring longer rehabilitation. Patients in whom outcome remains unclear need further assessment at 2 weeks, as these scores showed better correlation with outcome. The predictive ability of prognostic scores at 4 weeks was not significantly greater than at 2 weeks suggesting that 2 weeks was the optimum time for assessment for rehabilitation.

There is a wide spectrum of opinion on the process and results of stroke rehabilitation, especially in older patients (Chapter 1). A negative and nihilistic attitude towards stroke patients is inappropriate, but there is concern that unrealistic expectations from the rehabilitation process have resulted in inappropriate use of therapy resources and bed-utilisation (Chapter 1). Although it would be inconceivable to deny any stroke patient adequate treatment solely on the basis of severity of disability, there may be advantages, both for the patient and the hospital service in directing stroke unit resources towards patients most likely to benefit from such input.

This study was the preliminary step in defining prognostic criteria tailored for use in the elderly. It describes a methodology for selecting patients for stroke unit rehabilitation to achieve optimal and cost-effective utilisation of resources. It is, however, important to undertake further prospective studies on the sensitivity, reliability and repeatability of the suggested criteria in larger samples and to evaluate its ability to influence the effectiveness of stroke rehabilitation in practice.

CHAPTER 6. EVALUATION OF A CLINICAL PROGNOSTIC SCALE FOR OLDER STROKE PATIENTS.

6.1 INTRODUCTION

An accurate prediction of functional outcome following stroke is important not only for patients and their families but also for determining rehabilitation needs and long-term management strategies (Chapters 1, 4 & 5). Prognosis after stroke is related to the severity of initial impairments and disabilities and there are several ways of predicting outcome (Chapter 1). Selecting an appropriate prognostic scale for clinical and research use presents problems because of the controversy about the merits of different scores and their applicability to stroke rehabilitation (Chapter 1). Although neurological assessments can predict outcomes such as mortality or severe handicap, their ability to predict residual disability, discharge destination or continuing care needs is limited. Multivariate functional prognostic scores may be better predictors of functional recovery but lack validation in datasets other than those in which they were derived (Chapter 1).

It may be possible to achieve satisfactory prognostication and stratification of stroke survivors using simple single prognostic indicators (Chapter 1). A much-favoured indicator is urinary incontinence which has been shown to be superior to some prognostic scales used previously (Gladman, Harwood & Barer,1992). The use of a new score, such as the Orpington Prognostic Score (OPS), cannot be advocated in routine clinical practice until the score has been shown to have advantages over urinary incontinence as a prognostic indicator.

The role of OPS in prognostic stratification of stroke patients and its comparison with urinary incontinence as a prognostic indicator were studied prospectively in a large patient group which was different from the one in which the score was originally derived (Chapter 5).

6.2 METHOD

6.2.1 Subjects

This prospective study was undertaken in 217 stroke survivors over 75 years of age admitted to hospital over a 2 year period. Patients with first as well as recurrent stroke were included in the study. The diagnosis of stroke was based on history and clinical examination. CT scanning was not routinely undertaken but performed when there were doubts about the clinical diagnosis (unclear history of focal neurological symptoms, atypical clinical features, atypical progression of stroke), cerebellar stroke or subarachnoid haemorrhage were suspected, or when anticoagulation was indicated or already being given to the patient (Dunbabin & Sandercock,1991; Hankey,1992a,b). Of the 217 stroke survivors studied, 39 (18%) patients had CT scans prior to inclusion for the above-mentioned reasons. Patients with dementia were included in the study for previously stated reasons (Chapter 5). Patients known to be institutionalised or severely dependent (Dependency level 3 - see below) because of recurrent stroke, other disabilities or cognitive impairment prior to the stroke were not included in the study.

6.2.2 Assessments

Details of age, gender, side of stroke, power in the arm and leg on the affected side [Medical Research Council grading], hemianopia, dysphasia, dysphagia, sensory deficits and Barthel ADL index on admission were recorded (Table 6.1). Urinary continence was assessed at 1, 2 and 4 weeks after stroke, both clinically and by analysis of nursing records for the 24 hour period preceding the assessment. Patients who were catheterised at the time of assessment were considered incontinent. Cognitive state was assessed using the abbreviated mental test score (MTS). OPS was measured in all stroke patients at 1, 2 and 4 weeks after stroke.

Table 6.1 Initial assessment in 217 older stroke survivors included in the study on evaluation of the Orpington Prognostic Score.

Clinical Features	
Left hemiplegia	110 (50.7%)
Right hemiplegia	96 (44.2%)
Brainstem/cerebellar	11 (5.1%)
Mean power in affected arm (triceps)	2.2±1.5 (MRC scale)
Mean power in affected leg (quadriceps)	2.8±1.2 (MRC scale)
Sensory Loss	42 (19.4%)
Hemianopia	67 (30.9%)
Dysphasia	39
Dysphagia	20 (9.2%)
Urinary Incontinence	119 (54.8%)
Median Barthel ADL index	3 (Range 0-7)

MRC: Medical Research Council
ADL: Activities of daily living

Stroke management was undertaken on general medical or rehabilitation wards. All stroke patients received physiotherapy and occupational therapy appropriate to their disability. Further input was provided by speech therapists, social workers and a nursing home placement officer. Prognostic scores and urinary continence data for the study were collected by a doctor (LK) and a physiotherapist not directly involved with day-to-day management of patients included in the study. Subjects were objectively monitored for progress and outcome using measures of neurological deficits, mobility and activities of daily living by the ward multidisciplinary teams at weekly intervals. As in the previous study (Chapter 5) professionals involved in the management of these patients were unaware of their prognostic scores or expected outcome.

The outcome measures used were the destination of discharge, Barthel index and the level of dependence at the time of discharge. Three levels of dependency were defined for the study based on clinical experience and observations in the practice of geriatric medicine (Table 6.2).

6.2.3 Dependency Levels

Level 1 (Table 6.2) was compatible with a good quality of life in the elderly with little or no support from family or other agencies. Level 2 (Table 6.2) was compatible with patients being able to stay at home if an able spouse or other competent carer were present. In patients living alone prior to stroke, it should have been possible to maintain them in the community with intermittent daytime support from statutory or voluntary agencies. Level 3 (Table 6.2) included patients requiring constant attention day and night. Such individuals would usually require institutional care.

It was expected that stroke patients achieving independence or limited dependence would be capable of "independent living", i.e. be able to return home or live in specially adapted environments (eg sheltered housing) with necessary support and avoid institutional care.

Table 6.2 Levels of dependence at discharge in stroke patients included in the study.

Level 1: Independent for personal ADL

a) continent

b) independently mobile (with/without aid)

c) independent in self-care abilities.

Level 2: Limited dependence for personal ADL

a) continent

b) not confused

c) Walks with supervision or intermittent help for balance or coordination.

d) Able to transfer, wash, dress and toilet with supervision or minimal help.

Level 3: Dependent for personal ADL

Any two of the following:

a) incontinent or requiring major help for toileting.

b) confused

c) unable to walk or requiring continuous support from one person who helps carrying weight or with balance.

d) requiring major help for feeding, washing and dressing.

6.2.4 Statistics

The sensitivity, specificity and accuracy of OPS and urinary continence in determining stroke patients achieving "discharge home" (independent living) was assessed by the formulae:

Sensitivity:

$$\frac{\text{number of patients discharged "home" as predicted (true positive)}}{\text{total number of patients discharged "home" (true positive + false negative)}}$$

Specificity:

$$\frac{\text{number of patients not discharged "home" as predicted (true negative)}}{\text{total number of patients not discharged home (true negative + false positive)}}$$

Accuracy:

$$\frac{\text{no. of independent living patients as predicted + institutionalised patients as predicted}}{\text{total no. of patients}}$$

The predictive values of various levels of OPS and urinary continence in predicting discharge home or into institutional care also were assessed. Predictive values for discharge home (OPS 2-5; urinary continence) and institutionalisation (OPS >5; urinary incontinence) were calculated as:

$$\frac{\text{no. of patients actually discharged home as predicted}}{\text{no. of patients predicted to go home}}$$

and

$$\frac{\text{no. of patients actually discharged to institutions as predicted}}{\text{no. of patients predicted to go into institutional care}}$$

6.3 RESULTS

6.3.1 Patient Characteristics

The mean age of the 217 patients (M:F ratio= 31:69) included in the study was 82.3±7.1 (SD) years. Previous strokes were recorded in 42 (19.4%) patients, 34 (81%) of which were on the same side and 8 (19%) were on the opposite side to the present stroke. The majority of patients (n=167) were independent in personal activities of daily living prior to the stroke and 108 of them lived alone. Dementia, diagnosed prior to the present admission, was present in 37 (17%) patients.

6.3.2 Stroke Outcome

Nearly one quarter of the older stroke patients were independent by the time of discharge from hospital and went home relatively early compared with patients in other groups (Table 6.3). They were characterised by low prognostic scores, urinary continence and a high Barthel index at discharge (Table 6.3). Outcome was more variable in patients achieving limited dependence. Urinary continence was achieved in all patients by the time of discharge, with nearly two-thirds of these patients being continent at 2 weeks (Table 6.3). Although all patients in this group could, in theory, have achieved independent living, only 64% were discharged to non-institutional environments (Table 6.3). Patients with high prognostic scores continued to remain dependent and were mostly discharged to institutional care. Nearly 80% of these patients were incontinent at the time of discharge.

Table 6.3 Prognostic scores and outcome in 217 stroke survivors over 75 years of age.

Dep. level:	Independent	Limited	Dependent
No of patients	54	129	34
OPS Range (med)			
1 week	2.4-4.8 (3.2)	4.0-6.4 (5.6)	5.6-6.8 (6.0)
2 weeks	2.0-3.2 (2.8)	3.2-4.8 (4.0)	5.2-6.8 (6.0)
4 weeks	*	2.4-4.8 (3.6)	4.8-6.8 (5.6)
Ur. continence			
1 week	43 (79%)	31 (24%)	0
2 weeks	51 (94%)	82 (64%)	4 (12%)
4 weeks	*	105 (81%)	7 (21%)
BADL (med)			
on admission	4	2	2
at discharge	17	14	8
change in BADL	12	12	6
Dx BADL (Range)	16-20	11-18	2-10
Dest. of dx			
prev. residence	54 (100%)	71 (55%)	5 (15%)
shelt. housing	-	12 (9%)	1 (3%)
inst. care	-	46 (36%)	28 (82%)

* Not assessed because 39 (72%) patients were discharged within 4 weeks.

med: median; Dep. Level: Dependency level at discharge;
BADL: Barthel Activities of Daily Living;
Ur: Urinary; Dx: Discharge; Dest.: Destination; prev: previous;
shelt: sheltered; inst: institutional.

6.3.3 Correlation of Prognostic indices

Prognostic scores measured at 1, 2 and 4 weeks were analysed to examine their relationship to functional outcome at each point in time. The strongest correlations between score ranges and levels of dependence were seen 2 weeks after stroke (Table 6.4). Over 90% of the patients in the independent group had OPS<3 and all the patients in the dependent group had OPS>5 at this time point. The percentage of patients in each prognostic category did not change significantly at 4 weeks, suggesting that there was little benefit in delaying assessments of prognosis beyond this period (Table 6.4). In contrast, urinary continence continued to improve beyond 2 weeks especially in the group with intermediate prognosis, 80% of whom were continent by four weeks and 100% by the time of discharge.

OPS and urinary continence measured at 2 weeks showed comparable and high sensitivity but low specificity for predicting independent living at discharge (Table 6.5). The predictive value of OPS was high at both extremes of the scale. The predictive value of OPS<3 was 100% for discharge home and that for OPS>5 was 82% for placement in institutional care. The predictive value of urinary continence for discharge home was high but incontinence was a poor predictor of institutionalisation (Table 6.5).

Table 6.4 Relationship between dependency level at discharge and the number of patients in each prognostic category at 1, 2 and 4 weeks.

Dep. level at discharge	OPS	Week 1	Week 2	Week 4
Independent	<3	35 (65%)	51 (94%)	54 (100%)
Limited	3-5	62 (48%)	129 (100%)	129 (100%)
Dependent	>5	34 (100%)	34 (100%)	32 (94%)

Table 6.5 Sensitivity, specificity, accuracy and predictive value of OPS and urinary continence 2 weeks after stroke.

Parameter	Outcome Measure	OPS	Continence
Sensitivity	independent living	96%	90%
Specificity	independent living	36%	39%
Accuracy	independent living	75%	66%
Pred. value:			
OPS <3	discharge home	100%	-
OPS 3-5	discharge home	55%	-
OPS >5	institutional care	82%	-
Continence	discharge home	-	79%
Incontinence	institutional care	-	57%

Dep: Dependency; OPS: Orpington Prognostic score.

6.4 DISCUSSION

In this prospective study, undertaken in a large group of older stroke patients (distinct from the group in which OPS was originally derived) Orpington Prognostic Score measured at 2 weeks was able to predict the level of dependence at discharge. It appears that stroke patients with OPS of less than 3 will regain functional independence and are likely to be discharged home. Patients with OPS greater than 5, especially four weeks after stroke, will have high dependency at discharge and require constant care, usually within institutions. In the "middle-group" of stroke patients who score 3-5 at 2 weeks, outcome may be variable and depend upon factors such as intensity and quality of rehabilitation, presence of a competent carer at home, support and expectations of the family, personality and motivation of the patient and availability of statutory as well as voluntary support systems in the community (Smith,1990).

6.4.1 Prognostic scores in older patients

Accurate prediction of outcome in stroke patients has not historically been possible despite extensive knowledge about factors which influence prognosis (Reding & McDowell,1989). Factor analysis studies using combinations of known determinants of outcome have failed to produce clinically useful predictive formulae. Many prognostic scores used previously have been based on neurological examination (Britton, De Faire, Helmers et al.,1980; Allen,1984a,b; Barer & Mitchell,1989) where the emphasis is on the site and extent of neurological damage. Although neurological measures remain important, they do not provide a reliable measure of functional abilities at discharge, which have greater influence on the level of disability, destination of discharge and support required following stroke. The need for prognostic indicators to include functional assessments is even more important in older people because of a high background level of disability (Carstairs,1976). Minor functional impairment may result in significant disability and high levels of dependence in elderly people. On the other

hand, elderly patients with significant neurological deficits in whom functional abilities are preserved may be able to enjoy a better quality of life compared with younger stroke patients because of diminished occupational, social and family responsibilities. This study shows that a function-based approach, such as that adopted in OPS, provides clinically useful predictive formulae which can overcome some of the problems encountered previously (Chapter 1).

Several prognostic scores incorporate measures of functional abilities (Prescott, Garraway & Akhtar,1982; Shah, Wade, Skilbeck & Langton-Hewer,1983; Vanclay & Cooper,1989). Barthel index at the time of admission or at commencement of rehabilitation is known to correlate significantly with functional outcome in stroke patients (Chapter 5). Barthel index, however, had lower predictive ability compared with OPS in the previous study (Chapter 5). The previous study also showed that OPS had a stronger overall relationship to functional outcome compared with the Edinburgh Prognostic Score, especially in patients with cognitive impairment [r^2=0.81 v 0.39] (Chapter 5). This may have been due to failure to include cognitive function in the multivariate analysis (Wade, Skilbeck & Langton-Hewer,1983; Shah, Vanclay & Cooper,1989) or the elimination of cognitive impairment as a significant variable during analysis (Prescott, Garraway & Akhtar,1982), mainly because these studies were undertaken in relatively young stroke patients. Prognosis is significantly influenced by the presence of dementia in elderly people as it limits their ability to learn new techniques (Chapter 5). This is reflected in OPS which includes a well-validated measure of cognition (Chapter 5).

To be clinically useful, a prognostic aid must be relevant to the generality of stroke patients, address questions of practical importance and incorporate different indices based on two or more simple clinical variables to take into account the diversity of types of patient and stroke (Barer & Mitchell,1989). This is true for OPS which is easy to use in any patient setting and, given its demonstrated suitability for patients over 75 years of age, applicable also to stroke patients of all ages. The scoring of OPS becomes similar to the Edinburgh Score in cognitively intact patients because the cognitive

measure in the score is weighted to give a zero bias in patients with no cognitive impairment. The Edinburgh Score has been well-validated in younger stroke patients previously (Garraway, Akhtar, Prescott & Hockey,1980; Garraway, Akhtar, Hockey & Prescott,1980; Prescott, Garraway & Akhtar,1982).

6.4.2 Comparison with urinary incontinence

The benefits of scoring systems such as OPS over single measures such as urinary continence in everyday clinical practice have been questioned (Barer & Mitchell,1989; Barer,1989; Gladman, Harwood & Barer,1992). Although the sensitivity, specificity and accuracy of urinary continence as a predictor were comparable to OPS in this study (Table 6.5), it lacked the predictive value of OPS in prognosticating the destination of discharge. It is likely that the predictive value of continence would have improved with time (Table 6.4) but the human and resource costs of negative or unrealistic expectations associated with delays in setting a prognosis need to be kept in mind (Barer & Mitchell,1989). The low predictive value of incontinence for institutionalisation is of concern. Stroke may not be the only factor contributing to incontinence in the elderly, and other causes such as dementia, prostatism, uterine prolapse and detrusor muscle instability may be important. Poor recording and reporting of incontinence, equivocal reasons for catheterisation and absence of established protocols in non-specialist settings may also affect reliable assessment of continence, reducing its overall predictive value. As OPS is an objective, bedside measure based on a simple clinical examination, it is less susceptible to such influences in everyday clinical practice.

6.4.3 Limitations of the OPS

Despite these advantages there are limitations in the use of OPS. The score is primarily aimed at rehabilitation and cannot be applied until patients'

neurological deficit and consciousness levels have stabilised. Difficulties in assessing proprioception or cognition in patient with aphasia or confusion may adversely affect the reliability of OPS, although this was not a major problem in practice as visual prompts, in addition to verbal instructions, were used in conducting these assessments. It is likely that the higher scores obtained in these patients reflected prognostic disadvantages associated with communication or learning difficulties and did not significantly influence the prognostic grouping.

6.4.4 Outcome measures in stroke

Judging outcome in elderly stroke survivors presents problems (Chapter 1). Outcome can be measured as the percentage of patients going home, but this may depend upon factors other than disability due to stroke (Ebrahim,1990; Smith 1990). The concept of "independent living" used in this study was considered to be a more sensitive measure than discharge home because it reflects available support in the community and other non-institutional options available to stroke patients. Another way of judging outcome is to measure functional recovery using the Barthel index at discharge. Although this has the advantage of avoiding the distorting influence of social factors and has general applicability to any healthcare system (Wade, Skilbeck, Langton-Hewer,1983), its ability to reflect real-life situations following discharge in individual patients remains open to question (Garraway, Akhtar, Hockey & Prescott,1980; Wade,1986). A scale of dependency has been described in this study taking into account the complex interrelationship between functional ability, support mechanisms and living accommodation (Granger, Sherwood & Garre,1977; Alexander & Eldon,1979) to enable a more accurate assessment of stroke outcome.

6.4.5 Other applications of OPS

Prognostic scores such as the OPS have applications other than predicting outcome in stroke survivors. Prognostic scores could be used to target scarce resources more appropriately by identifying patients most likely and those least likely (with very good or very poor prognosis) to benefit from intensive rehabilitation (Chapter 5). The identification of a "middle-group" of stroke patients is one of the most important functions of OPS. Prognosis in these patients is likely to be determined by local factors such as the availability, intensity and quality of rehabilitation input making it impossible to predict outcome reliably in every patient in every setting. There also is a real risk in more rigid prognostication within this group because such prognostic prophecies may become self-fulfilling, especially in difficult patients in whom aggressive therapy may be substituted by institutionalisation. It would be more appropriate if outcome in this group was determined by multidisciplinary monitoring of progress following directed therapy.

Another potential area for application of prognostic scores is in research. Objective assessment of the impact of available services or new developments on stroke outcome is difficult because of failure to standardise for the severity of stroke and prognosis (Wade,1992a). OPS can facilitate studies in this area by identifying a "middle group" of patients, who would be most sensitive to intervention, for inclusion in such studies.

It will never be possible to design a single simple mathematical model which can predict outcome in every single stroke patient because of the heterogeneity of the stroke population and distortions introduced by other variables. Criteria such as the Edinburgh or the Orpington score provide a statistical estimate of the potential for functional improvement or discharge home for groups of patients rather than for individuals. The level of rehabilitation required by an individual stroke patient remains a clinical decision but its targeting can be facilitated by scoring systems based on clinical determinants.

CHAPTER 7. RANDOMISED CONTROLLED STUDY OF THE EFFECTIVENESS OF A STROKE REHABILITATION UNIT.

7.1 INTRODUCTION

Organisation of rehabilitation is a key consideration in stroke management. Treatment of stroke on general wards has been criticised because of poor coordination between disciplines, lack of planning consistent with patients' needs or abilities and breakdown of communication between professionals, patients and carers (Chapter 1). Dissatisfaction with standards of provision of care on general medical wards has resulted in the development of more specific strategies in stroke management over the last decade (Langton-Hewer,1990). Although intensive treatment of stroke patients may be beneficial (Peacock, Riley, Lampton et al., 1972; Sivinius, Pyorala, Heinonen et al.,1985), the benefits of stroke intensive care units (Kennedy, Pozen & Gabelman,1970; Drake, Hamilton, Carlsson & Blumenkrantz,1973; Norris & Hachinski,1976; Millikan,1979) remain equivocal (Indredavik, Bakke, Solberg et al.,1991; Wade,1992a; Langhorne, Williams, Gilchrist & Howie,1993). A recent meta-analysis of stroke units suggests that they reduce mortality (Langhorne, Williams, Gilchrist & Howie,1993) and there is some evidence that stroke rehabilitation units also may reduce disability and long-term institutionalisation (Reding & McDowell,1989; Ebrahim,1990; Wade,1992a). Despite several studies to evaluate the benefits of such units, their effectiveness remains controversial. (Garraway, Akhtar, Prescott & Hockey 1980; Hamrin,1982a; Stevens, Ambler & Warren,1984; Dobkin,1989; Edmans & Towle,1990; Friedman,1990; Ebrahim,1990; Indredavik, Bakke, Solberg et al.,1991).

Measurement of differences in stroke rehabilitation is difficult and assessing the effectiveness of stroke rehabilitation units is complicated because of:

1) the heterogeneity of patient characteristics,

2) failure to stratify for severity of stroke which determines both prognosis as well as the level of resources needed (Spence & Donner,1982),

3) the variety of settings in which stroke is treated,

4) differences in quantity and quality of treatment received by patients,

5) variation in resources allocated to stroke management and the organisation of services,

6) difficulties in disentangling the effects of differing service organisation from the effects of different types and duration of treatment received by patients, and finally,

7) difficulties in assessing objectively the impact of available services or new developments because of the lack of baseline information and poor quality of data collected in this field (Wade,1992a).

The present study is a randomised controlled trial comparing therapy input and outcome in stroke patients, stratified according to expected prognosis (Chapter 5 & 6), who were managed either on general wards or a stroke rehabilitation unit.

7.2 PATIENTS AND METHODS

7.2.1 Patients

Subjects for the study were recruited from 377 stroke patients admitted to a general hospital over 18 months. As in previous studies (Chapters 4, 5 & 6), stroke was defined as acute onset of neurological deficit lasting more than 24 hours or leading to death, with no apparent cause other than cerebrovascular disease (WHO,1989). Patients with first (83%) as well as recurrent strokes (17%) were included in the study. The diagnosis of stroke was based on history and clinical examination. Computerised tomography (CT) scanning was not routinely undertaken (Chapters 4 & 6) except when indicated by defined criteria (Table 7.1). Eighty-two (22%) of the 377 stroke patients had CT scans. The study was approved by the Bromley Ethics Committee as a variation in service organisation because there would be no decrease in the existing provision of care to stroke patients as a result of the project.

Table 7.1 Indications for CT scan.

1) Doubts about clinical diagnosis
    a) Unclear history of focal neurological symptoms
    b) Atypical clinical features
    c) Atypical progression of stroke after onset
2) Patient under 60 years of age with no vascular risk factors
3) Cerebellar stroke suspected
4) Subarachnoid haemorrhage suspected
5) Anticoagulation indicated or already being given
6) Carotid endarterectomy being considered

As the incidence of stroke increases with age, 42 (11%) patients with dementia were included in the study since this frequently complicates stroke rehabilitation in the older age group (Ebrahim, Nouri & Barer,1985). In keeping with previous studies (Chapters 4, 5 & 6) and for similar reasons, no attempts were made to classify dementia patients into multi-infarct or Alzheimer's type. Patients with space occupying lesions, cerebral metastatic disease, low-pressure hydrocephalus, congenital malformations, head injury or central nervous system (CNS) infections on clinical or CT evidence were excluded from the study. Although CT scanning was undertaken in all patients in whom the clinical diagnosis of stroke was equivocal, the possible limitation of not having 100% CT scanning is acknowledged.

Of the 377 patients diagnosed as having stroke, CT scans demonstrated subdural haematomas in 2 and brain tumours in 7 patients. Seventy-nine (21%) patients died and 37 (10%) patients with mild deficits secondary to reversible ischaemic neurological disease were discharged within 2 weeks of admission and, hence, excluded from the study. The remaining 252 survivors at 2 weeks were entered into the study.

7.2.2 Initial management, randomisation & stratification

Details of age, gender, side of stroke, power in the arm and leg on the affected side (Medical Research Council grading), hemianopia, dysphasia, dysphagia, sensory deficits, inattention (visual/sensory), continence, mobility, Barthel ADL index and cognitive state (MTS) were recorded in all stroke patients using the methodology previously described (Chapters 2 & 4).

Stroke patients were admitted to general medical wards during the acute phase of their illness for initial management and stabilisation. Following initial management on general wards, stroke survivors at 2 weeks were randomly allocated to the stroke rehabilitation unit (Chapter 3) or continued to be managed on general medical wards according to existing practices. The restricted randomisation procedure was used

(Daly, Bourke & McGilvray,1991). It was decided that of every 10 stroke patients suitable for inclusion, half would be managed on the stroke unit and the other half would remain on the general wards. The table of random numbers (Geigy Scientific Tables, 1982) was used, but after 5 patients were allocated to any one group, the remaining patients in the block were allocated to the other group. This randomisation was built into the Orpington Stroke Management System programme (Chapter 2) for the purposes of the study, so that the system patient number on entry dictated the rehabilitation setting in which the patient was to be managed.

Patients in each limb of the study were "standardised" for severity of stroke and expected outcome by stratification into groups according to the Orpington Prognostic score (OPS) (Chapters 5 & 6). Three groups were identified: patients with mild to moderate deficits showing the best prognosis (prognostic score <3), patients with moderate to severe deficits in whom prognosis was intermediate (prognostic score 3-5) and patients with very severe deficits who had poor prognosis (prognostic score >5).

7.2.3 Therapy input

Despite different settings, all stroke patients had unrestricted and equal access to nursing care, physiotherapy and occupational therapy. The type of physiotherapy used was based on Bobath principles but modified by the physiotherapists' experience. Physiotherapy and occupational therapy input were provided by therapists of comparable seniority (Senior I grade) and experience, who were assisted by therapy aides in both settings. Nurses and therapists working on the stroke rehabilitation unit had no formal specialist training in the management of stroke patients (Chapter 3). Input also was provided in both settings by speech therapists, social workers and nursing home placement officer for patients unable to return home.

7.2.4 Data collection

Subjects were followed from entry to the study until discharge from hospital. Objective assessments for neurological deficit, cognitive function, continence, mobility and activities of daily living were undertaken at weekly intervals in both groups.

As there are no accepted measures of process, measures of physiotherapy and occupational therapy input (major and universally available components of the rehabilitation) were defined for the study. These included the duration and type of therapy given to individual stroke patients which were recorded by therapists working with the patients. Duration was measured in 30 minute time units of face-to-face contact with patients. The major categories of the type of treatment given to stroke patients were agreed upon by therapists and the proportion of time devoted to different activities within each discipline was recorded. Therapists involved in assessment and day to day management of stroke patients were unaware of their participation in the study or expected outcome.

A range of measures was used to assess outcome because of the known problems with any single measure (Chapters 1 & 2). Primary outcome measures included mortality during hospital stay, the percentage of patients discharged home, the percentage of patients discharged to long-term institutional care and the length of hospital stay. As stroke is predominantly a disease of the elderly in whom destination on discharge may depend on factors other than stroke (Chapter 1), Barthel ADL index at discharge, change in Barthel ADL index from inclusion in the study to discharge and the proportion of patients with Barthel ADL index of >11 in each group were also recorded.

7.2.5 Statistics

The sample size was calculated by using a comparison nomogram (Altman,1980) to include the minimum number of patients in each prognostic group to give the study 90% power at the 5% significance level for primary outcome measures

(destination of discharge: 10% difference, median discharge Barthel ADL scores: 2 point difference, length of hospital stay: 20% difference) based on observations in previous studies (Chapters 4, 5 & 6). Group-homogeneity was analysed with χ^2 test for gender, neurological deficits, dementia, recurrent strokes and prognostic classification in each group. Age on admission, motor power on affected side and Barthel ADL index on initial assessment were analysed by the Mann-Whitney test. Mortality, destination of discharge, differences in the type of therapy received and the proportion of patients with Barthel ADL index >11 at discharge in each group were analysed using the χ^2 test. Statistical analysis was not undertaken if any cell had 0 value or a value of <5 was present in >20% cells. The length of hospital stay, amount of therapy received, discharge Barthel index and change in Barthel index during rehabilitation was analysed by the Mann-Whitney Test.

7.3 RESULTS

Of the 252 patients in the study 126 were treated on the stroke rehabilitation unit and 126 on general medical wards. Seven patients (2 from the stroke rehabilitation unit, 5 from general medical wards) were transferred to other hospitals (out of district residents or to be closer to relatives) and did not complete the study.

7.3.1 Baseline characteristics of stroke patients

The baseline characteristics of the 124 patients managed on the stroke unit were comparable to the 121 patients treated on general medical wards (Table 7.2). Patients with an intermediate prognosis formed the largest group accounting for nearly 60% of patients in both settings. The extent of neurological deficit, mobility and functional abilities at the initial assessment in patients treated on the stroke rehabilitation were comparable with those treated on general wards.

Table 7.2 Baseline characteristics of stroke patients on the stroke rehabilitation unit and general medical wards at the time of inclusion into the study.

Clinical features	Stroke Unit	General wards	p
No. of patients	124	121	NS
Age (mean±SD yrs)	77.8 (11.4)	78.6 (12.2)	NS
Gender (% female)	56%	59%	NS
Recurrent strokes	14	11	NS
Dementia	7	8	NS
Recurrent stroke and dementia	3	4	NS
Left hemiplegia	59	58	NS
Right hemiplegia	55	51	NS
Brainstem/cerebellar	10	12	NS
Prognostic groups:			
OPS score <3	31	32	NS
OPS score 3-5	75	71	NS
OPS score >5	18	18	NS
Mean power arm (triceps)*	2.3±1.7	2.6±1.2	NS
Mean power leg (quadriceps)*	3.1±1.4	3.0±1.6	NS
Sensory Loss	16	14	NS
Hemianopia	42	39	NS
Sensory/visual inattention	54	57	NS
Dysphasia	26	23	NS
Dysphagia	11	9	NS
Median FAC score (Range)	1 (0-3)	1 (0-3)	
Median Barthel ADL index (Range)	5 (0-12)	5 (0-14)	NS
CT scans	32	29	NS

* Medical Research Council grading for power on the affected side (weaker side in patients with bilateral signs)

OPS: Orpington Prognostic Scale (Table 2)
FAC: Functional Ambulation Categories
ADL: Activities of daily living
CT: Computerised tomography

7.3.2 Therapy Input

Patients treated on general medical wards received significantly more physiotherapy on average than patients on the stroke rehabilitation unit during their hospital stay (Table 7.3). A greater proportion of physiotherapy input on stroke rehabilitation ward was directed towards individual needs of patients compared with general medical wards ($p<0.001$). There were no differences in the average amount of occupational therapy received by patients in either setting. A significantly greater proportion ($p<0.001$) of time on the stroke rehabilitation unit was spent on specific needs of individual patients compared with general medical wards (Table 7.3).

7.3.3 Outcome

The study showed significant differences in the overall outcome between stroke patients managed on the stroke unit (n=124) and general wards (n=121). A greater proportion of patients managed on the stroke unit were discharged home (72.5% v 57%; $p<0.01$) and had better median Barthel index at discharge (15 v 13) compared with patients on general medical wards. The mean length of hospital stay was also significantly shorter in patients managed on the stroke unit (40.3 $\pm$ 14.2 days v 83.6 $\pm$ 32.7 days). Although overall mortality was lower in patients managed on the stroke unit (7% v 12%), this failed to achieve statistical significance.

There were no significant differences in functional abilities at discharge, destination of discharge (Fig 7.1) or length of hospital stay in stroke patients with a good prognosis (OPS <3) managed in either setting (Table 7.4). One patient managed on general medical wards required long-term care because of social circumstances rather than disability (Barthel ADL index 16).

Table 7.3 Comparison of therapy input in stroke patients managed on the stroke rehabilitation unit (SU) with those managed on general medical wards (GMW).

Therapy input and type	SU n=124	GMW n=121	p
PHYSIOTHERAPY			
Mean duration/patient (hours)*	14.3±3.2	16.2±7.2	<0.05
No. of half-hour sessions spent on:			
Sitting balance	486 (13.7%)	580 (14.8%)	
Standing balance	720 (20.3%)	855 (21.8%)	
Transfers	571 (16.1%)	596 (15.2%)	
Ambulation	734 (20.7%)	858 (21.9%)	
Individual rehabilitation**	1036 (29.2%)	1031 (26.3%)	<0.02†
OCCUPATIONAL THERAPY			
Mean duration/patient (hours)*	9.5±3.2	9.3±2.8	NS
No. of half-hour sessions spent on:			
Personal ADL	1430 (60.7%)	1476 (65.6%)	
Kitchen activities	245 (10.4%)	216 (9.6%)	
Home visits	304 (12.9%)	333 (14.8%)	
Post-discharge follow up	106 (4.5%)	58 (2.6%)	
Individual rehabilitation**	271 (11.5%)	166 (7.4%)	<0.001†

* Time spent in face-to-face activities with the patients excluding administrative time
† largest determinant of a significant two-sided χ^2 test for independent proportions.

ADL: Activities of daily living.

** Individual rehabilitation: Time spent on activities aimed at addressing specific needs of individual patients (eg specific transfer/washing/dressing techniques, use of aids) identified by the therapist or the patient as contributing significantly to discharge to the chosen environment.

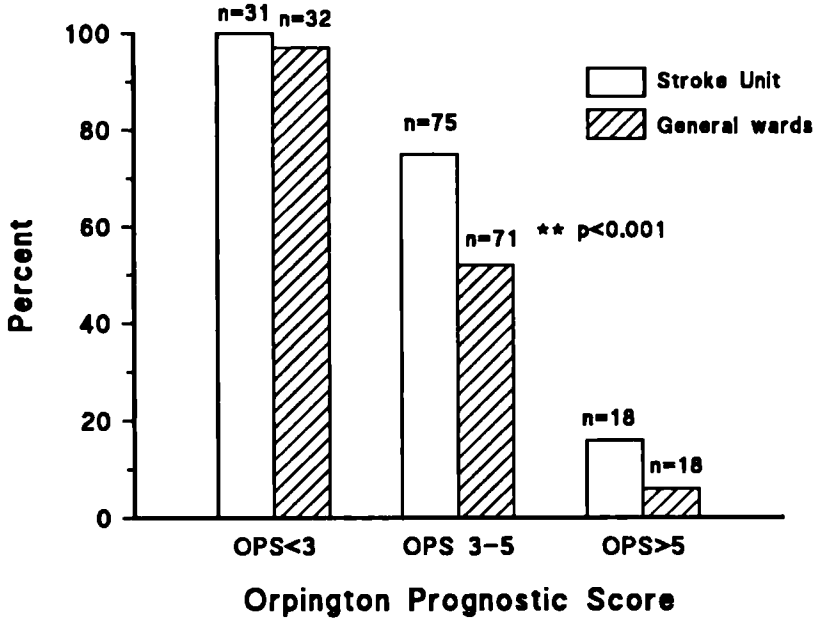


Fig 7.1 Comparison of the percentage of stroke patients with good (OPS <3), intermediate (OPS 3-5) or poor (OPS >5) prognosis discharged home from the stroke unit or general wards.

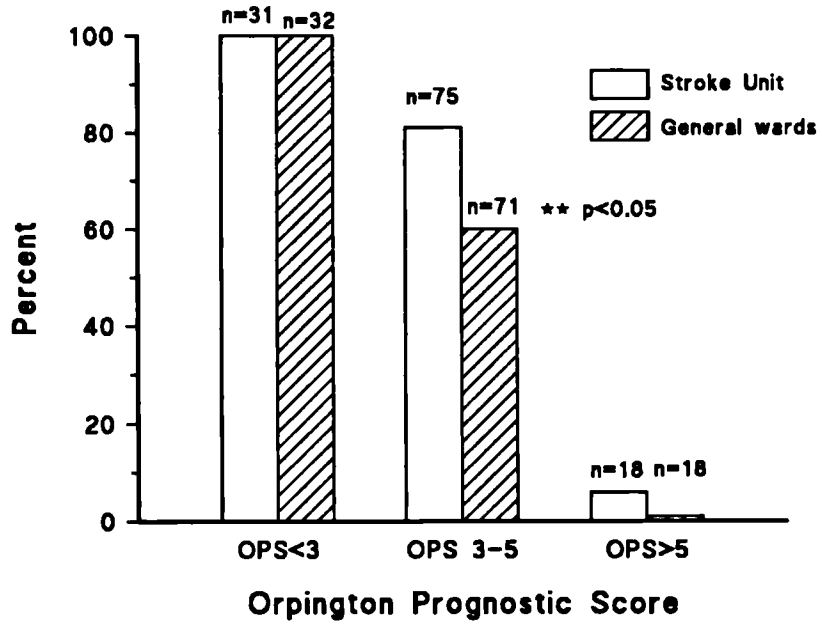


Fig 7.2 Comparison of the percentage of stroke patients in each prognostic group discharged with Barthel index >11 from the stroke unit or general wards.

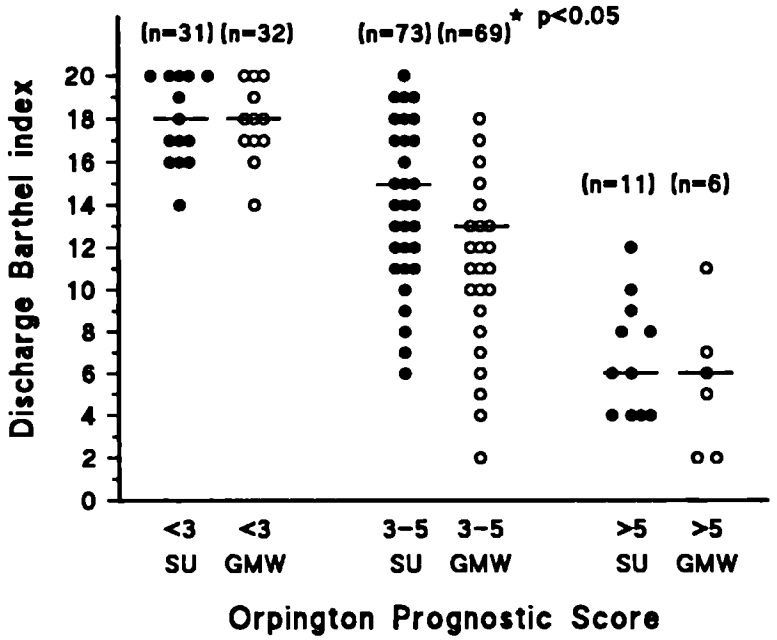


Fig 7.3 Comparison of discharge Barthel index in stroke survivors with good (OPS <3), intermediate (OPS 3–5) or poor (OPS >5) prognosis managed on the stroke unit (SU) or general wards (GMW).

—— Median Barthel index (● = Stroke Unit; o = General wards)

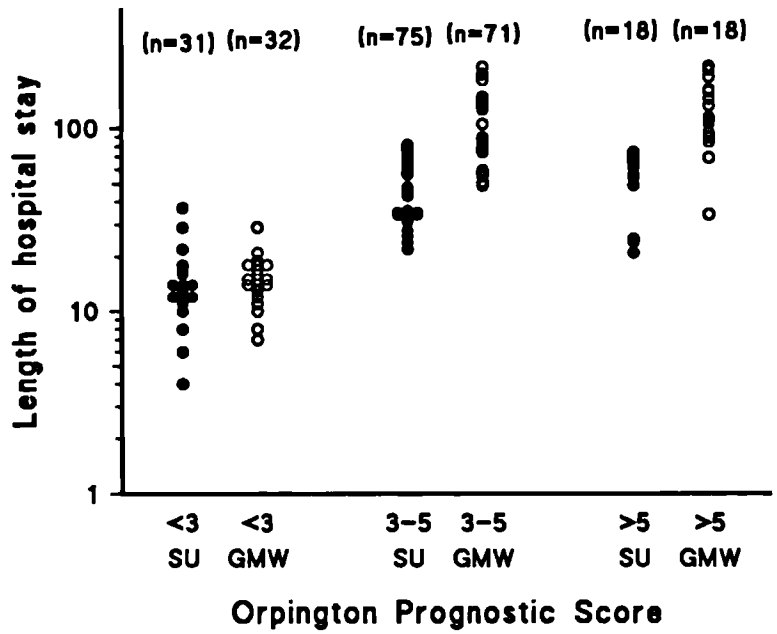


Fig 7.4 Comparison of lengths of hospital stay in stroke patients with good (OPS <3), intermediate (OPS 3–5) or poor prognosis (OPS >5) managed on the stroke unit (SU) or general wards (GMW).

(● = Stroke Unit; o = General wards)

Although mortality was high in severely disabled patients with poor prognosis (OPS >5) in both settings, a relatively greater number of patients died on general medical wards compared with the stroke unit (Table 7.4). Clinical causes of deaths included aspiration pneumonia, pulmonary embolism, recurrent stroke and unrelated myocardial infarction. Functional abilities and destination at discharge of survivors were comparable between the two groups (Table 7.4).

The greatest differences between the stroke unit and general medical wards were seen in stroke patients with intermediate prognosis (OPS 3-5). A significantly greater proportion of patients managed on the stroke rehabilitation unit was discharged home compared with general medical wards (Fig 7.1). In addition, patients with an intermediate prognosis (OPS 3-5) managed on the stroke unit had better functional abilities at discharge (Fig 7.2) and shorter lengths of hospital stay (Table 7.4).

7.4 DISCUSSION

This study, undertaken in stroke patients stratified for neurological deficit and prognosis, demonstrates that organised and directed stroke management leads to greater recovery of function (Fig 7.3) and more rapid discharge from hospital (Fig 7.4) without any major increase in time allocated by therapists. Patients with moderately severe deficits and intermediate prognosis appear to benefit most by stroke unit rehabilitation compared to those with mild or very severe deficits (Fig 7.3 & 7.4). Although it would have been desirable to undertake further assessments of outcome (using additional measures of quality of life, patient satisfaction and carer stress) at 3 or 6 months after discharge, this was not possible because of lack of resources.

Patients with dementia and recurrent strokes were included in the study to make the sample more representative of the stroke population. Early mortality (within the first 2 weeks) was high and less than 40% patients in these groups survived long enough to be included in the study (Table 7.2). The distribution of patients with dementia and/or

recurrent stroke surviving long enough to be included was comparable between the stroke unit and general medical wards (Table 7.2). The prognostic disadvantages due to dementia or recurrent strokes were reflected by the higher OPS scores (Chapter 5 & 6) in these patients and their inclusion did not compromise the value of the study.

Computerised tomography was not undertaken routinely in this study. Several studies have shown that CT scanning has a limited role in the diagnosis of stroke and does not predict or influence functional outcome in stroke patients (Sandercock, Molyneaux & Warlow,1985; Sotaniemi, Phytinen & Myllyla,1990; Ricci, Celani, LaRosa et al., 1991; Dunbabin & Sandercock,1991; Wade 1992). It may not be possible or necessary to CT scan every stroke patient for current indications, even in health care systems such as the British National Health Service (Langton-Hewer & Wood,1989). Rapid access to expert clinical evaluation of neurological deficit with urgent access to CT scanning and neurosurgical facilities if required may be a more appropriate strategy in stroke management (Wade,1992a) and has been followed in this study.

A double blind study was not possible because of the logistics of separate wards and the nature of intervention. The possibility of bias introduced by observer preference or by differences in staff and patient motivation because of perceived discrimination by allocation to the stroke unit must be recognised. These pitfalls were reduced by "blinding" nursing and therapy staff to prognostic scores and outcome measures. The broad categories of therapy input were decided amongst professionals in advance. Therapists or clinicians involved in management on the stroke unit did not provide input to general medical wards and hence were unable to influence therapy input or outcome in these settings. Finally, ensuring an even mix of patients with good as well as poor prognostic expectations in both settings prevented nihilistic or negative attitudes amongst staff or patients in either setting, reinforcing the validity of findings of this study.

Inter-observer differences in assessments may be another possible source of potential error in this study. This possibility was reduced by using a well-validated scale (the Barthel Index) as a primary outcome measure. The robustness of Barthel Index

in multiple assessments undertaken by different observers is well-known and has been discussed in Chapter 1. Barthel assessments for the study were undertaken by occupational therapists of equivalent seniority (Senior I) in both settings which would have further reduced the possibility of bias due to inter-observer differences. Other outcome measures included mortality and hospital length of stay, both of which are considered to be independent of observer bias. The limitations of length of hospital stay as an outcome measure and the justification for its use in the study have been discussed in section 1.6.5.

Prognostic stratification, on the other hand, was achieved by using a relatively new scale developed during this study (Chapter 5 & 6). Preliminary data from further studies in over 300 stroke patients participating in ongoing validation of the Orpington Prognostic Score (OPS) suggests a high degree of agreement between therapists involved in assessment for stroke rehabilitation and between these therapists and LK in prognostic scoring using the OPS.

7.4.1 Comparisons with previous studies

The conflicting results of previous studies on the benefits of stroke units using similar outcome measures may have been due to the types of patients recruited to these studies. Results of the present study show that patients with mild deficits achieve independence in personal ADL regardless of their setting whereas those with very severe deficits and poor prognosis do not regain significant basic functional abilities regardless of management on a stroke unit. Whilst most studies are controlled for the severity of deficit, there is little information about the actual proportion of patients with different levels of disability (Chapter 1). Inclusion of a large proportion of patients at either end of the spectrum would minimise differences between stroke units and general wards and may have been responsible for the negative results in some controlled studies (Hamrin,1980a; Stevens, Ambler & Warren,1984; Edmans & Towle,1990).

Table 7.4 Outcome according to prognostic groups in patients treated on the stroke unit (SU) and on general medical wards (GMW).

Prognostic score	<3					3-5					>5				
	SU (n=31)		GMW (n=32)		p	SU (n=75)		GMW (n=71)		p	SU (n=18)		GMW (n=18)		p
Measures:	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%	
Mortality	0	-	0	-	-	2	3	3	4	NS	7	39	12	67	NS
Discharge Home	31	100	31	97	NS	56	75	37	52	<0.001	3	16	1	6	NS†
Long-term care	0	-	1	3	-	17	22	31	44	<0.001	8	45	5	23	NS
Discharge BADL >11	31	100	32	100	NS	61	81	42	60	<0.05	1	6	0	0	-
Median discharge BADL*	18		18		NS	15		13		<0.05	6		6		NS
Median change in BADL*	12		12		NS	12		8		<0.05	4		4		NS
Length of stay (mean±SD days)	13.2±6.7		14.6±4.2		NS	48.7±17.2		104.6±28.6		<0.001	52.3±19.8		123.2±48.2		<0.001

* Barthel index measured in survivors

† Fisher's exact test

BADL: Barthel ADL index

7.4.2 Effects on mortality

There was a trend towards higher mortality in patients with a poor prognosis managed on general wards compared with the stroke unit although this did not achieve significance (Table 7.4). The possibility of Type II error due to small numbers cannot be excluded because mortality was not taken into consideration in determination of sample size. However, significant reduction in mortality on stroke units has been observed elsewhere (Indredavik, Bakke, Solberg et al,1991) and has also been shown in a meta-analysis of controlled studies on the benefits of stroke units (Langhorne, Williams, Gilchrist & Howie,1993). This may be due to better management of swallowing problems and awareness of other complications such as deep vein thrombosis on stroke units, although no definite conclusions can be drawn from this study.

7.4.3 Stroke unit outcome and its determinants

As stroke is predominantly a disease of advancing years, assessing outcome of rehabilitation, even in the short-term, presents problems (Chapter 1). The number of patients discharged home is a simplistic measure and does not take into account other factors which may influence discharge. To enable a more accurate evaluation of rehabilitation outcome, measures of functional ability have also been included in this study (Table 7.4). Previous experience has shown that patients with Barthel ADL index >11 require supervision or intermittent help for walking and self-care and can be maintained at home (Chapter 6). The percentage of patients achieving this functional level was greater than that of those discharged home in both settings and appears to be a better measure of stroke rehabilitation outcome. However, the effectiveness of stroke rehabilitation cannot be assessed by one measure in isolation and it would be more appropriate to use a combination of measures when evaluating the effectiveness of strategies in stroke management (Chapter 1).

Several factors may have contributed to the improved outcome on the stroke rehabilitation unit and it is difficult to isolate specific components important to overall results. Despite the general belief that patients on stroke units do better because of increased therapy input, this was not the case in the study. In keeping with another study (Garraway, Akhtar, Prescott & Hockey,1980), results showed that the average duration of therapy input on the stroke unit was less than that on general medical wards. The type of treatment, however, differed in that it was specifically matched to individual patient needs on the stroke unit and may have contributed significantly to the observed differences in outcome. Better multidisciplinary coordination with patients and carers, a positive attitude amongst nurses (Gibbon,1991) and their involvement as informal therapists may have been another factor responsible for improved outcome. The psychological impact of being on the stroke unit also may have contributed by boosting patients' morale and motivation to achieve greater functional independence. These interactive effects are highly complex and have not been assessed in this study.

7.4.4 Patient selection in stroke rehabilitation

This study has demonstrated that patient selection can significantly influence the quantitative results of stroke unit management. While it is inconceivable to deny any stroke patient adequate treatment solely on the basis of severity of disability, there may be advantages both for the patient and the hospital service in directing stroke unit resources towards patients most likely to benefit from such input (Chapter 5 & 6). With the exception of a small group of patients with poor prognosis in whom mortality may be reduced, rehabilitation on stroke units would be of little benefit to stroke survivors who would do well or those who would do badly whatever their setting or therapy input. It appears that patients with moderately severe deficits and intermediate prognosis are most appropriate for stroke unit rehabilitation. Identification of this subgroup of patients can be facilitated by incorporating major determinants of outcome into a well-defined set of simple but objective clinical criteria, such as the Orpington

Prognostic Score, which can be applied in day-to-day hospital work and by professionals who may not be medically trained.

It should be remembered that while criteria of patient selection may affect the overall operational effectiveness of stroke rehabilitation units, they cannot predict suitability for intensive rehabilitation in every single stroke patient. Hence, these criteria should be used as guidelines and selection of patients for stroke unit rehabilitation needs to remain flexible depending upon the individualised multidisciplinary assessment of patients' needs.

CHAPTER 8. THE INFLUENCE OF STROKE UNIT REHABILITATION ON FUNCTIONAL RECOVERY FROM STROKE.

8.1 INTRODUCTION

Treatment of stroke is expensive and accounts for 10% of district bed-day costs in Britain (Wade, Wood & Langton-Hewer,1985; OHE,1988). As the major proportion of in-patient costs of stroke are incurred in meeting acute rehabilitation needs of these patients (Wade & Langton-Hewer, 1985; Bamford, Sandercock, Warlow & Gray,1986), recent years have seen an increasing emphasis on developing cost-effective strategies in this area. One of the strategies gaining increasing acceptance is the establishment of specialist units for stroke rehabilitation (Chapter 7). Despite several studies on the benefits of stroke units in the last decade, positive benefits in reducing mortality and shortening hospital lengths of stay have only recently become apparent (Chapters 1 & 7). The effects of stroke unit rehabilitation on functional recovery continue to remain controversial.

There is some evidence that stroke units hasten discharge from hospitals (Ebrahim,1990; Friedman,1990; Indredavik, Bakke, Solberg et al.,1991; Wade,1992a; Chapter 7). Shorter lengths of hospital stay on stroke units could be due to quicker functional recovery (Ebrahim,1990; Indredavik, Bakke, Solberg et al.,1991) or a result of better organisation and coordination between patients, carers and professionals in expediting discharge from hospitals (Consensus Conference,1988). The debate between these two aspects of stroke unit rehabilitation has not been resolved unequivocally (Wade,1992a).

The objective of this analysis of data collected in the randomised controlled study (Chapter 7) was to compare the rate of functional recovery and therapy

input in stroke patients managed on the stroke rehabilitation unit (Chapter 3) with that of similar patients managed on general wards. The contribution of the rate of functional recovery to the length of hospital stay was also assessed.

8.2 METHODS

Data for this study were collected during the randomised controlled study comparing outcome in stroke patients managed on the stroke unit or on general wards using methodology previously described (Chapter 7). All patients with an intermediate prognosis (OPS 3-5) managed either on the stroke unit or on general wards were included in the present analysis.

Patients in both settings were assessed at weekly intervals and their Barthel ADL index recorded by occupational therapists who were not aware of the possible use of these assessments in a comparative study at a later date. In patients discharged before 12 weeks, a further functional assessment was undertaken at 12 weeks during a post-discharge visit by the therapists. As therapy input received by patients may influence not only the level but also the rate of functional recovery, the duration and the type of physiotherapy and occupational therapy received by patients were recorded. Data was also collected on the number of deaths and discharges in either setting. Patients who died during their hospital stay or before the follow-up visit were excluded from subsequent analysis (stroke unit 2, general wards 3).

Data collected in the remaining 73 patients on the stroke unit and 68 patients on general wards were analysed for the median discharge Barthel index and median Barthel index at 0,1,2,3,4,6,8,10 and 12 weeks in the two groups. In the absence of any agreed measures of the rate of functional improvement, the time taken by each group to achieve the median discharge Barthel index was considered representative. Similarly, the differences in organisational aspects between the two settings were represented by the time required to discharge patients remaining in hospital after the median discharge Barthel index was achieved in each group.

Age on admission, motor power on the affected side and duration of therapy received by patients were analysed using the Student's t test. Comparability of gender, neurological deficits and the type of therapy received by patients in either setting were analysed by χ^2 test. The median Barthel index at different time intervals was analysed by the Mann-Whitney test. The z test was used to analyse differences in the rate of change of median Barthel index and discharge rates between the two groups.

8.3 RESULTS

The baseline demographic characteristics of the 73 patients on the stroke unit and 68 patients on general wards were comparable (Table 8.1). The extent of neurological deficit, frequency of urinary incontinence and initial Barthel index in patients treated on the stroke rehabilitation unit did not differ significantly from patients treated on general wards (Table 8.1).

The overall change in the Barthel index from the time of randomisation to discharge from hospital was significantly greater in patients managed on the stroke unit (Fig 8.1). The median discharge Barthel index of patients managed on the stroke rehabilitation unit was significantly higher than that of patients managed on general wards (15 v 12). Despite a similar median Barthel index for both groups at the start of the study, median Barthel indices, measured at weekly intervals, were significantly higher for patients managed on the stroke rehabilitation unit compared with those on general wards (Table 8.2). The increase in median Barthel index in the stroke unit group was initially slow but rose rapidly after 2 weeks reaching a plateau at median discharge Barthel index at 6 weeks (Fig 8.2). Median Barthel index for patients on general wards showed little improvement for 3 weeks, after which they improved linearly until the median discharge Barthel index was achieved at 12 weeks (Fig 8.2). The rate of change of median Barthel index during the linear phase was significantly slower in patients on general wards (0.9/week) compared with those on the stroke unit (2.2/week) and is

reflected by the difference in the slopes of their Barthel curves (Fig 8.2). The mean value of Barthel index of individual patients at 4 weeks as a proportion of their Barthel index at discharge was 0.79±0.22(SD) on the stroke unit compared with 0.66±0.22 (SD) on general wards ($p<0.01$).

Patients managed on the stroke unit had significantly shorter mean length of hospital stay compared with those on general wards (48.7±17.2 v 104.6±28.6 days; $p<0.001$). There were no significant differences between the percentage of patients discharged from the stroke unit (50%) and general wards (45%) up to the time taken to achieve median discharge Barthel index in each group. Significant differences, however, were seen in the time taken to discharge patients remaining on general wards once this level was achieved (20 weeks) compared with the stroke unit (6 weeks). The mean value of the time taken to achieve discharge Barthel index by individual patients as a proportion of the duration of their hospital stay after randomisation was 0.91±0.4 (SD) for patients on the stroke unit compared with 0.65±0.27 (SD) for patients on general wards ($p<0.01$).

Differences in the speed of functional recovery were also seen when median Barthel indices of patients remaining on the stroke rehabilitation unit or general ward were plotted against time (Fig 8.3). There was a shift to the right in the curve representing median Barthel index in the general ward group suggesting slower changes. The peak of the Barthel index curve coincided with the beginning of the sharp rise in the discharge curve, both on the stroke unit and general wards confirming that patients with poorer functional recovery stayed longer in hospitals regardless of setting (Fig 8.3).

Patients with intermediate prognosis managed on general wards received significantly more physiotherapy on average than patients on the stroke rehabilitation unit during their hospital stay (Table 8.3). There were no differences in the average amount of occupational therapy received by patients in either setting. Although there was a trend towards a higher proportion of occupational therapy time being spent on specific needs of individual patients on the stroke rehabilitation unit compared with general medical wards, this did not achieve statistical significance (Table 8.3).

Table 8.1 Demographic characteristics of stroke patients in the "middle" prognostic group (OPS 3-5) managed either on the stroke unit (SU) or general wards (GW).

Clinical features	SU	GW	p
No. of patients	73	68	NS
Age (mean±SD yrs)	78.4 (7.6)	78.4 (8.6)	NS
Gender (% female)	58%	62%	NS
Left hemiplegia	36	34	NS
Right hemiplegia	35	32	NS
Brainstem/cerebellar	4	5	NS
Mean power in arm (triceps)*	2.0±1.4	2.2±1.3	NS
Mean power in leg (quadriceps)*	3.1±1.3	3.1±1.0	NS
Perceptual deficits	24	23	NS
Hemianopia	28	26	NS
Dysphasia	15	13	NS
Dysphagia	4	3	NS
Urinary incontinence	25	24	NS
Median Barthel ADL index (Range)	4 (0-12)	4 (0-8)	NS

* Medical Research Council grading for power on the affected side
ADL: Activities of Daily Living
OPS: Orpington Prognostic Scale

Table 8.2 Median Barthel index (Range) and discharge rates on a weekly basis in stroke patients managed on the stroke unit (SU) or general medical wards (GMW).

Time	median BADL (Range)			percentage discharges		
	SU	GMW	p	SU	GMW	p
Week 0	4 (0-12)	4 (0-8)	0.2	0	0	-
Week 1	6 (0-13)	4 (0-12)	0.002	-	-	
Week 2	9 (0-15)	4 (0-13)	0.001	0	0	-
Week 3	11 (0-18)	5 (0-16)	0.001	-	-	
Week 4	13 (0-20)	6 (0-17)	0.001	8	0	0.001
Week 6	14 (3-20)	8 (2-18)	0.001	50	0	0.001
Week 8	15 (4-20)	9 (2-18)	0.001	55	5	0.001
Week 10	15 (6-20)	10 (2-18)	0.001	84	20	0.001
Week 12	15 (6-20)	12 (2-18)	0.001	100	45	0.001
Week 20	-	12 (2-18)	-	-	73	-
Week 28	-	12 (2-18)	-	-	97	-
Week 32	-	12 (2-18)	-	-	100	-
Discharge	15 (6-20)	12 (2-18)	0.001			

BADL: Barthel Activities of Daily Living index

Table 8.3 Comparison of therapy input in stroke patients managed on the stroke unit (SRU) with those managed on general wards (GW).

Therapy input and type	SU n=73	GW n=68	p
PHYSIOTHERAPY			
Mean duration/patient (hours)*	16.6±4.7	21.5±7.9	<0.05
Percentage time spent on:			
Sitting balance	14.2%	14.3%	NS
Standing balance	21.1%	21.3%	NS
Transfers	17.5%	19.3%	NS
Ambulation	20.0%	20.8%	NS
Individual rehabilitation**	27.1%	24.3%	NS
OCCUPATIONAL THERAPY			
Mean duration/patient (hours)*	10.2±3.1	10.4±3.2	NS
Percentage time spent on :			
Personal ADL	57.6%	61.8%	NS
Kitchen activities	11.1%	11.7%	NS
Home visits	14.0%	14.2%	NS
Post-discharge follow up	4.8%	3.4%	NS
Individual rehabilitation**	12.5%	8.9%	NS

* Time spent in face-to-face activities with the patients excluding administrative time

ADL: Activities of Daily Living.

** Individual rehabilitation: Time spent on activities aimed at addressing specific needs of individual patients (eg specific transfer/washing/dressing techniques, use of aids) identified by the therapist or the patient as contributing significantly to discharge to the chosen environment.

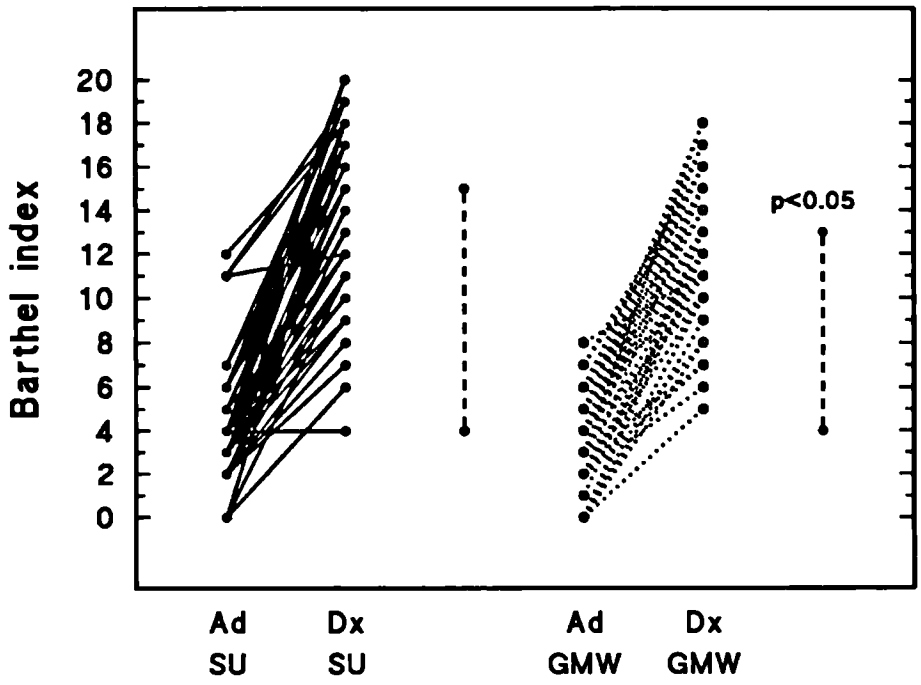


Fig 8.1 Change in the Barthel ADL index from admission to discharge in stroke survivors in the intermediate group (OPS 3–5) managed on the stroke unit (SU) n=73; or on general wards (GMW), n=68.

Broken lines represent median change in Barthel index for each group.

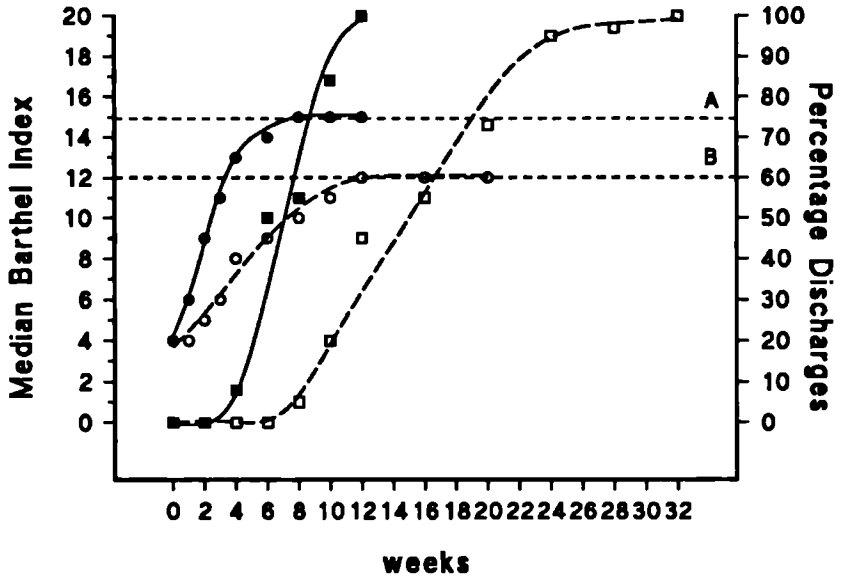


Fig 8.2 Weekly median Barthel index and discharge rates of stroke survivors on stroke unit (n=73) and general wards (n=69).

● = Median Barthel Index (Stroke Unit) ■ = Percentage Discharges (Stroke Unit)

o = Median Barthel index (General Ward) □ = Percentage Discharges (General wards)

A = median discharge Barthel index of stroke unit group

B = median discharge Barthel index of general wards group

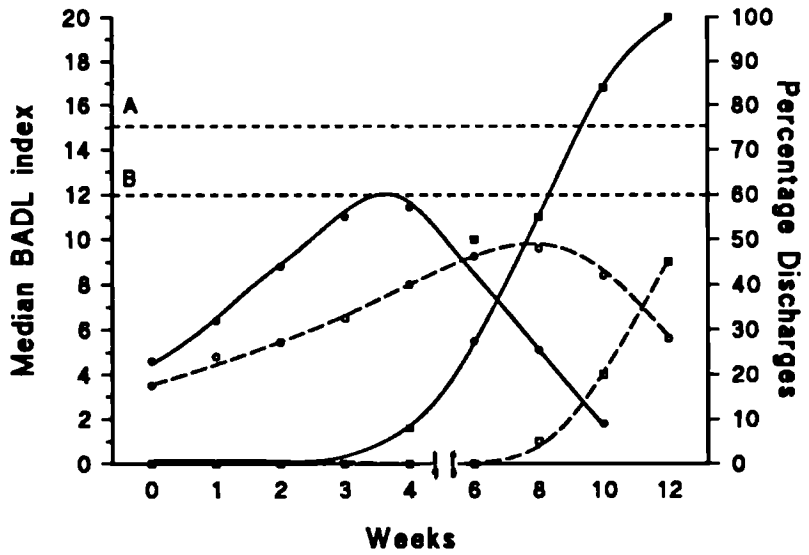


Fig 8.3 Weekly median Barthel index of the remaining stroke inpatients on the stroke unit and general wards shown against the rate of discharge.

o = Barthel index (General wards) □ = Discharge rates (General wards)

● = Barthel index (Stroke Unit) ■ = Discharge rates (Stroke Unit)

A = median discharge Barthel index of stroke unit group

B = median discharge Barthel index of general ward group

8.4 DISCUSSION

Functional recovery, as measured by Barthel index, was not only greater but also significantly more rapid on the stroke rehabilitation unit compared with general wards. This improvement was achieved without any additional physiotherapy or occupational therapy input in the specialist setting (Chapters 3 & 7). Close liaison between patients, carers and professionals resulting in a mechanism of expediting discharges in appropriate patients may also have contributed to the shorter hospital stay on the stroke rehabilitation unit.

The present analysis was limited to patients in the "middle" prognostic group because this group has been shown to be most sensitive to stroke unit intervention (Chapter 7). Patients in the good prognostic group were considered inappropriate for the study because of the high initial Barthel index and short duration of hospital stay in both settings (Chapter 7). Analysis was not possible in the group with poor prognosis because of the small sample size, high mortality and the small change in median Barthel index between admission and discharge regardless of setting (Chapter 7).

The reasons why stroke rehabilitation units shorten hospital lengths of stay have not been clear in the past (Wade,1992a). Although quicker functional recovery has been suggested (Ebrahim,1990; Indredavik, Bakke, Solberg et al.,1991), the possibility of organisational aspects resulting in better coordination and early discharges as the sole contributing factor has also existed (Garraway, Akhtar, Hockey & Prescott,1980; Consensus Conference,1988; Wade,1992a). The faster rate of functional improvement seen in this analysis has also been reported previously although therapy input was not quantified in the previous study (Indredavik, Bakke, Solberg et al.,1991). In addition, the duration over which patients remaining in hospital were discharged after the median discharge Barthel index was achieved was significantly longer on general wards (Table 8.2) providing objective evidence of the poor organisation suspected in previous reports (Consensus Conference,1988; WHO,1989). The group observations of speedier recovery and quicker discharges once functional potential was achieved on the stroke unit were

supported by data on the proportion of change in Barthel index occurring in the first 4 weeks and the proportion of time spent in hospital once discharge Barthel index was achieved in individual patients.

There is a risk that average lengths of hospital stay may be artificially shortened by discharging stroke patients before they achieve their functional potential. This risk is even greater in specialist settings, such as a stroke unit, where one of the measures of efficacy may be a shorter length of hospital stay. If this were the case in the present study, the median Barthel index of the patients remaining on the stroke rehabilitation unit would either remain static or even rise as more of the severely disabled patients were discharged home or institutionalised. The fall in median Barthel index of patients remaining on the stroke unit would indicate that the discharge process was appropriate without undue delays or premature discharges (Fig 8.3). Another way of judging appropriateness of discharge may have been to monitor readmission rates, but this was not a part of the original protocol because of lack of resources for monitoring beyond discharge form hospital.

An inherent weakness in this study is that the functional assessments were undertaken by therapists involved in treating patients. It would have been desirable to "blind" assessment procedures but this was not possible because of the logistic problems of conducting several assessments in a large group of patients at timed intervals. Bias in favour of either setting is unlikely because of the large number of assessments undertaken, the consistency between serial assessments and the correlation between Barthel index and outcome in individual patients. The probability of bias is further reduced by the fact that the therapists conducting these assessments were unaware of a possible comparison between settings at a later date.

This study provides the basis for developing a service model for functional recovery from stroke and its relationship to hospital stay. Changes in the median Barthel index of stroke patients undergoing rehabilitation are initially slow, but then rise linearly and plateau once the median discharge Barthel index has been achieved. The plot of discharge of stroke patients from hospital shows a similar pattern but follows

functional improvement. The steep phase of the discharge curve begins only when median discharge Barthel levels are achieved by the patient group (Fig 8.2). The rapid discharge phase is associated with a rapid fall in median Barthel index of the remaining patients (Fig 8.3). This model generates measures by which the functional efficacy of stroke settings (different stroke units or different specialist and non-specialist settings) may be assessed. The suggested measures (which need to be applied to patient groups of comparable deficits and prognosis) are:

1) the median discharge Barthel index (measure of the extent of functional recovery in the setting),

2) time required by the patient group to achieve this index (measure of the rate of functional recovery in the setting),

3) time required to discharge the remaining stroke patients once the group achieves the median discharge Barthel index (measure of mechanisms to expedite discharges from the setting), and

4) the rate of decrease of median Barthel index of patients remaining on the unit after median Barthel index is achieved (measure of appropriateness of discharges from the setting).

It is possible that other assessments (eg motor, functional and social) in stroke show similar patterns and relationship to discharges. It may also be possible that some of these measures are affected by stroke unit rehabilitation whereas others are relatively immune to such influences. Further research in this area will allow a more precise understanding of how stroke units affect rehabilitation and help in developing better strategies of stroke management.

CHAPTER 9. THE EFFECTS OF AGE GROUP ON STROKE UNIT REHABILITATION.

9.1 INTRODUCTION

Age is an important consideration in the epidemiology and management of stroke (Bamford, Sandercock, Dennis & Warlow,1988,1990). Demographic trends and epidemiology data suggests that stroke in older patients will be a major health issue in the near future with significant cost implications (Chapters 1 & 4). The hospital costs of stroke are predicted to rise out of proportion to the overall number of stroke patients because of the higher proportion of older stroke patients requiring hospitalisation for nursing, rehabilitation and social reasons (Chapters 1 & 4).

One of the strategies gaining increasing popularity is the establishment of specialist units for stroke rehabilitation (Chapters 1, 7 & 8). The randomised controlled study on the benefits of the stroke unit suggested that stroke units speed functional recovery and shorten hospital lengths of stay (Chapters 7 & 8). Stroke patients, however, are a heterogeneous group varying in age, stroke severity and additional disability which may affect the rehabilitation process. Despite the possibility of benefits from stroke unit rehabilitation varying in different groups of stroke patients, there is little information available on the influence of these factors on stroke unit rehabilitation (Wade ,1992).

The benefits of stroke units may be influenced by the age of patients, not only because of factors related to ageing but also because of the availability of resources for older people. The additional needs of older people and less focussed attitudes on general medical wards may make them the patient group most likely to benefit from specialist stroke unit rehabilitation. Conversely, they may represent a group less likely to benefit from such efforts because of problems associated with the ageing process. However, little is known about this aspect of stroke rehabilitation.

The organisation of services in Bromley presented an opportunity to undertake an analysis according to age group in stroke patients participating in the randomised controlled study (Chapter 7).

9.2 METHODS

The 245 stroke patients included in this analysis, definition and diagnosis of stroke, inclusion and exclusion criteria and the methodology of randomisation, stratification and management of patients have been described previously (Chapter 7).

As previously stated, stroke patients were admitted to general wards during the acute phase of their illness for initial management and stabilisation. The district (Bromley, Kent), in common with several districts in Britain at the time of the study, had an age-related admissions policy according to which patients over 75 years of age were admitted to different acute wards from those who are under 75 years of age regardless of admission diagnosis or the time of admission. All wards were situated in the same acute hospital and the age division was purely an operational policy issue with no particular gerontological significance.

Patients in both age groups were randomly allocated to the stroke rehabilitation unit or continued to be managed on general medical or geriatric medical wards according to existing practices. As described previously (Chapter 7), all stroke patients had access to nursing care, physiotherapy and occupational therapy despite different settings. Physiotherapy and occupational therapy input were provided by therapists of comparable seniority who were assisted by therapy aides. Input was also available from speech therapists, social workers and a nursing home placement officer for patients unable to return home. Multidisciplinary discussions on patients' progress and therapy strategies took place every morning on the stroke unit. Similar discussions took place on a weekly basis on geriatric medical wards. There was no formal multidisciplinary discussion on general medical wards. The duration and type of therapy

given to individual stroke patients were recorded by therapists working with the patients as described previously (Chapter 7). Therapists involved in the assessment and day to day management of stroke patients were unaware of their participation in the study or expected outcome.

Subjects were followed up from entry to the study until discharge from hospital. Objective assessments for neurological deficit, cognitive function, continence, mobility and activities of daily living were undertaken at weekly intervals. Outcome measures included mortality during the remaining hospital stay, the percentage of patients discharged home, the percentage of patients discharged to long-term institutional care and the length of hospital stay (Chapter 7). Barthel ADL index at discharge, the change in Barthel ADL index from inclusion in the study to discharge and the proportion of patients with a Barthel ADL index of >11 at discharge were also recorded (Chapter 7).

Group comparability was analysed with a χ^2 test for gender, neurological deficits, dementia, recurrent strokes and prognostic classification in each group. Age on admission, motor power on the affected side and Barthel ADL index on initial assessment were analysed by the Mann-Whitney test. Mortality, destination of discharge, differences in the type of therapy received and the proportion of patients with Barthel ADL index >11 at discharge in each group were analysed using the χ^2 test. The length of hospital stay, amount of therapy received, discharge Barthel index and change in Barthel index during rehabilitation were analysed by the Mann-Whitney Test.

9.3 RESULTS

9.3.1 Patient characteristics

Of the 245 patients in the study, 101 (41.2%) were under 75 years of age whereas 144 were aged 75 years or more (Table 9.1). The majority of patients (87%) did not have a history of previous stroke. Dementia was present in 22 (9%) patients prior to

the stroke. Sixty-one (25%) patients included in the study had CT scans. CT scanning was more common in younger than in older patients (43 v 18, $p<0.01$).

Young and old stroke patients were equally distributed between the stroke unit and general medical or geriatric medical wards and the baseline characteristics of each age group were comparable between the two settings (Table 9.1). The extent of neurological deficit, mobility and functional abilities at the initial assessment in patients of both age groups treated on the stroke rehabilitation were comparable to their counterparts treated on general medical or geriatric medical wards.

Recurrent stroke and/or dementia were significantly more common in stroke patients over 75 years as a group regardless of the rehabilitation setting (8 v 39; $p<0.05$). There was also a significantly greater proportion of females in the older age group (38% v 72%; $p<0.05$) which was equally distributed between general wards and the stroke unit (Table 9.1). The site of stroke, neurological deficit and functional disability as measured by Barthel index at initial assessment were comparable between the two age-groups and the two setting for each group (Table 9.1). Although prognostic scores were significantly higher ($p<0.01$) for older patients as a group suggesting a poorer prognosis in these patients, the three prognostic groups were equally distributed between the stroke unit and general wards in both age groups (Table 9.1). Patients with intermediate prognosis formed the largest group irrespective of age or setting.

9.3.2 Process

Younger stroke patients treated on general medical wards received the same duration of physiotherapy and occupational therapy on average as those of the same age managed on the stroke unit (Table 9.2). A greater proportion of physiotherapy and occupational therapy input was directed towards individual needs in younger patients managed on the stroke rehabilitation unit compared with general medical wards (Table 9.2).

The average duration of physiotherapy received by older stroke patients

was similar to that received by younger patients on the stroke unit. A greater proportion of physiotherapy input on the stroke unit was devoted to more basic activities such as transfers in older patients compared with younger patients in whom more time was devoted to gait correction and individual rehabilitation (Table 9.2). Despite the mean duration of physiotherapy being significantly longer in older stroke patients managed on geriatric medical wards, the proportion of time spent on different activities was comparable to older patients managed on the stroke unit.

Older patients as a group received more occupational therapy input compared with younger patients regardless of setting (Table 9.2). There were no significant differences in the proportion of time spent on various occupational therapy activities between young and old patients on the stroke unit or between older patients managed on the stroke unit or general wards (Table 9.2). A significantly greater proportion of time was spent on personal ADLs in younger patients on general medical wards compared with the stroke unit where a greater proportion of time was devoted to individual rehabilitation (Table 9.2).

9.3.3 Outcome

There were significant differences in outcome between stroke patients under 75 years of age managed on general medical wards compared with those managed on the stroke unit (Table 9.3). A greater number of patients were discharged home from the stroke unit with the majority of patients achieving a Barthel index >11 (Table 9.3). The median discharge Barthel index and the change in Barthel index was also significantly greater in young patients managed on the stroke unit. There were, however, no significant differences in mortality between general wards (n=3) and the stroke unit (n=3) in this age group (Table 9.3). Older patients (aged over 75 years) showed a relatively higher mortality on general wards (n=12) compared with the stroke unit (n=6). There were no significant differences in functional abilities or destination on discharge in survivors managed on the stroke unit or general wards (Table 9.3). The

median length of hospital stay of young and old patients managed on the stroke unit was significantly less than in patients managed on general medical or geriatric medical wards. Outcome in any setting or age group was not influenced by the gender of the patient.

A comparison between young and old stroke patients managed on the stroke unit showed significantly better outcome in younger patients (Table 9.3). A higher proportion of younger patients were discharged home and achieved a higher Barthel index during their hospital stay. There were no significant differences in outcome between young stroke patients managed on general medical wards and older stroke patients managed on geriatric medical wards, except for a shorter duration of hospital stay in younger patients (Table 9.3).

The better outcome seen in younger (aged <75 years) patients may have been due to the higher proportion of patients with a good prognosis compared with a higher proportion of patients with a bad prognosis in the older (aged >75 years) group (Table 9.1). The independent effect of age on outcome, hence, was assessed in the patients in the "middle" prognostic group because it was shown to be most sensitive to therapy intervention in a previous chapter (Chapter 7). The differences in outcome between young and old stroke patients managed on the stroke unit and young patients managed on the stroke unit and general wards continued to be significant despite standardisation for prognosis (Table 9.4). Younger patients managed on general medical wards, however, had a significantly poorer outcome compared with older patients of similar prognostic expectations managed on geriatric medical wards (Table 9.4).

The effect of age on stroke unit rehabilitation was also assessed using age as a continuous variable in multiple regression analysis. Other independent variables included gender, prognostic grouping and the setting of stroke management. Patient age, in addition to prognostic grouping and setting, had a significant influence on discharge Barthel Index in favour of younger patients (Coeff: -0.06; $p<0.03$). Other outcome measures (destination of discharge and length of hospital stay) were not significantly affected by patient age, but were significantly influenced by prognostic grouping and setting of management.

Table 9.1 Baseline characteristics of young (age <75 years) and old (age 75+ years) stroke patients randomly allocated to the stroke unit (SU) or general medical wards (GMW) at the time of inclusion into the study.

Clinical features	young (<75 years)		old (75+ years)	
	SU	GMW	SU	GMW
No. of patients	53	48	71	73
Age (mean±SD yrs)	71.4 (4.1)	71.6 (6.2)	82.6 (4.5)	83.2 (4.9)
Gender (% female)	36%	40%	71%	72%
Recurrent strokes	3	2	11	9
Dementia	1	1	6	7
Recurrent stroke & dementia	0	1	3	3
Left hemiplegia	26	26	33	32
Right hemiplegia	26	18	29	33
Brainstem/cerebellar	1	4	9	8
Mean power in arm*	2.4±1.6	2.7±1.4	2.0±1.4	2.1±1.6
Mean power in leg*	3.1±1.8	2.9±1.3	3.2±1.2	3.3±0.9
Perceptual deficits	18	17	22	19
Hemianopia	18	14	24	25
Dysphasia	11	11	15	12
Dysphagia	3	3	8	6
Median BADL (Range)	5 (0-10)	5 (0-12)	4 (0-10)	5 (0-12)
Prognostic groups:				
OPS score <3	20	18	11	14
OPS score 3-5	28	27	47	44
OPS score >5	5	3	13	15

* Medical Research Council grading for power in affected limb.
OPS: Orpington Prognostic Scale
BADL: Barthel Activities of Daily Living index

Table 9.2 Comparison of therapy input in young and old stroke patients managed on the stroke rehabilitation unit (SU) with those managed on general medical wards (GMW).

Therapy input and type	young (<75 years) SU n=53 I	young (<75 years) GMW n=48 II	p	old (75+ years) SU n=71 III	old (75+ years) GMW n=73 IV	p	p IvIII	p IIvIV
PHYSIOTHERAPY								
Mean duration/patient (hours)*	14.1 ± 4.6	15.4 ± 7.8	NS	15.2 ± 6.7	18.4 ± 9.6	0.05	NS	0.05
No. of half-hour sessions spent on:								
Sitting balance	158 (11%)	167 (11%)	NS	328 (15%)	413 (15%)	NS	NS	NS
Standing balance	243 (17%)	302 (20%)	NS	477 (22%)	553 (21%)	NS	NS	NS
Transfers	81 (6%)	152 (12%)	0.05	490 (24%)	644 (26%)	NS	0.05	0.01
Ambulation	372 (26%)	431 (29%)	NS	362 (17%)	427 (16%)	NS	0.05	0.01
Individual rehabilitation**	559 (40%)	427 (28%)	0.05	477 (22%)	604 (22%)	NS	0.01	NS
OCCUPATIONAL THERAPY								
Mean duration/patient (hours)*	7.9 ± 4.1	7.6 ± 3.7	NS	10.7 ± 2.4	10.4 ± 3.1	NS	0.01	0.01
No. of half-hour sessions spent on:								
Personal ADL	516 (61%)	557 (72%)	0.05	914 (60%)	919 (61%)	NS	NS	0.05
Kitchen activities	105 (13%)	94 (12%)	NS	140 (9%)	122 (9%)	NS	NS	NS
Home visits	80 (9%)	92 (12%)	NS	224 (15%)	241 (15%)	NS	NS	NS
Post-discharge follow up	20 (2%)	0 (0%)	-	86 (6%)	58 (5%)	NS	NS	-
Individual rehabilitation**	117 (14%)	28 (4%)	0.05	154 (10%)	138 (10%)	NS	NS	0.05

* Time spent in face-to-face activities with the patients excluding administrative time

** Individual rehabilitation: Time spent on activities aimed at addressing specific needs of individual patients (eg. specific transfer/washing/dressing techniques, use of aids) identified by the therapist or the patient as contributing significantly to discharge to the chosen environment.

Table 9.3 Outcome in all (n=245) young and old stroke patients treated on the stroke unit (SU) or general medical wards (GMW).

	younger patients (<75 years)					older patients (75+ years)					p	
	SU (n=53) I		GMW (n=48) II		p	SU (n=71) III		GMW (n=73) IV		p	IvIII	IIvIV
Measures:	No.	%	No.	%		No.	%	No.	%			
Mortality	3	6	3	6	NS	6	8	12	17	NS	NS	NS
Discharge Home	44	83	29	60	<0.01	46	65	40	55	NS	0.05	NS
Long-term care	6	11	16	33	<0.01	19	27	21	28	NS	0.05	NS
Discharge BADL >11	46	87	33	69	<0.05	47	65	43	59	NS	0.05	NS
Median discharge BADL*	17		13		<0.05	14		13		NS	0.05	NS
Median change in BADL*	12		9		<0.05	11		10		NS	NS	NS
Median length of stay (days)	27		56		<0.01	36		84		<0.001	NS	NS

BADL: Barthel ADL index

* Barthel index measured in survivors

Table 9.4 Outcome in the middle group (OPS= 3-5; n=146) of young and old stroke patients treated on the stroke unit (SU) or general medical wards (GMW).

Patient age	Stroke Unit					General Wards					p	
	<75yrs (n=28) I		>75 yrs (n=47) II		p	<75yrs (n=27) III		>75yrs (n=44) IV		p	IvIII	IIvIV
Measures:	No.	%	No.	%		No.	%	No.	%			
Mortality	1	4	1	2	NS	1	4	2	5	NS	NS	NS
Discharge Home	23	82	33	70	<0.05	11	41	26	61	<0.01	<0.01	NS
Long-term care	4	14	13	28	<0.05	15	56	16	34	<0.01	<0.01	NS
Discharge BADL >11	26	93	35	74	<0.01	14	52	28	64	<0.05	<0.01	NS
Median discharge BADL*	17		14		<0.05	11		13		NS	<0.05	NS
Median change in BADL*	12		11		NS	8		10		NS	<0.05	NS
Median length of stay (days)	36		43		NS	59		88		<0.01	<0.01	<0.001

BADL: Barthel ADL index

* Barthel index measured in survivors

9.4 DISCUSSION

Patients under 75 years of age managed on the stroke unit showed the best outcome on a number of measures. The outcome in patients over 75 years of age managed on the stroke unit was not as good as in their younger counterparts and was comparable to patients managed on geriatric medical wards, even after standardisation for prognosis. Patients under 75 years of age managed on general medical wards had poorer outcome than older patients with similar prognostic expectations managed on geriatric medical wards, suggesting that younger stroke patients benefited more by stroke unit rehabilitation compared with patients over 75 years of age.

These differences in outcome could be due to age, per se, or differences in patient characteristics, rehabilitation input or prognostic expectations between the two groups. In keeping with demographic trends (Muir-Gray,1985), a significantly greater proportion of older stroke patients were women but this did not appear to influence outcome in this study. Higher prevalence of disabilities due to generalised osteoarthritis, visual and/or auditory impairment unrelated to stroke and other degenerative processes (Muir-Gray,1985) as well as recurrent stroke and dementia (Table 9.1) could have been additional contributing factors in the older age group. Despite these differences, deficits due to the present stroke and the initial Barthel ADL index were comparable between the two age groups suggesting that there were no significant functional differences between them. The limited sensitivity of Barthel ADL index and the poor relationship of neurological deficits to functional disability needs to be acknowledged (Seale & Davies,1987; Wade & Collins,1988; Keith,1990).

Differences in the process of stroke rehabilitation may have been another factor responsible for the differences in outcome between the two age groups (Table 9.3). It was possible that younger patients on the stroke unit received more therapy time which may have influenced outcome favourably in this group. Results, however, showed no major differences in the duration of therapy input or the type of treatment received by the two age groups managed on the stroke unit (Table 9.2). Similarly there were no

differences between the average duration of therapy received by younger stroke patients in either setting. A greater proportion of therapy time on general wards, however, was devoted to transfers and personal ADL abilities compared with the stroke unit where a significant proportion of time was devoted to the specific needs of individual patients. There were no significant differences in therapy input between the stroke unit and geriatric medical wards in older stroke patients.

The prognostic composition of younger and older stroke patients was different in both settings and the older age group was skewed towards a poorer prognosis. This heterogeneity in prognosis could not only explain the poorer outcome in older patients managed on the stroke unit but also could have masked more subtle differences between the two groups (Chapters 6 & 7). It was not possible to study the effects of age within each prognostic grouping because of the small sample size of the "good" and "poor" prognostic groups. The sample size of the "intermediate" prognostic group was adequate to allow further analysis and confirmed the differences in outcome between the two age groups managed on the stroke unit as well as the comparability of outcome in older patients managed in either setting. Whereas outcome was similar between general medical and geriatric medical wards when prognosis was not controlled (Table 9.3), significant differences emerged after standardisation of prognosis (Table 9.4).

Operational differences in service provision on general wards, where age has, in some circumstances, led to segregation of stroke patients in Britain may be an important determinant of stroke outcome. The differences between stroke patients managed on general medical or geriatric medical wards could not be explained by patient characteristics, prognosis or therapy input. Organisation of available therapy resources on general medical wards, however, appeared to be uncoordinated with emphasis on achieving minimum standards for early discharge. This contrasted with the existence of an established rehabilitation philosophy based on multidisciplinary practices in the geriatric medical wards concerned (for review of these issues see Horrocks,1986). Organisation of services has been criticised in the past and may have contributed

significantly to the observed differences in non-specialist settings (Consensus Conference,1988). It is possible that some of the age differences between young patients managed on the stroke unit or general wards may have been reduced if coordinated multidisciplinary input was available to younger stroke patients outside the stroke unit (Walsh, Barnes & McLellan,1988).

A recent study from Newcastle compared stroke management on geriatric medical wards with general medical wards (Aitken, Rodgers, French et al.,1993). The study concluded that there were no significant differences in outcome in older stroke patients managed in either setting and that delays in transfer to geriatric wards did not adversely affect stroke management in the elderly. There are, however, significant differences between the two studies. A high proportion of stroke patients in the Newcastle study were excluded for various reasons (only 67 out of 398 stroke patients were finally included compared with 245 out of 377 in the present study) and the study was limited to older stroke patients initially admitted to general medical wards. Randomisation was undertaken at 24 hours and could have resulted in differences in outcome being confounded by variables such as early stroke mortality, minor strokes and early discharges which are not influenced by rehabilitation input. Finally, the emphasis of the study was to prove that older stroke patients on medical wards were not adversely affected by delays in transfer to geriatric medical wards rather than to assess objectively stroke outcome in each setting.

A more recent American study on the effects of age on stroke rehabilitation concluded that age-associated factors influenced inpatient rehabilitation, treatment and outcome in patients over 75 years of age (Falconer, Naughton, Strasser & Sinacore,1994). Results showed that older patients had significantly shorter hospital rehabilitation stays compared with younger patients. Older patients, however, had poorer motor (and presumably functional, although this was not measured) abilities at discharge and were more often discharged to a nursing home. The results of the American study are difficult to compare with the present study because of failure to stratify for severity of stroke and the vast differences between the US and British health systems. It is possible

that inpatient stays in the USA are determined by payment considerations rather than by actual need, resulting in inappropriate discharges to institutional care regardless of the potential to achieve functional independence.

This study suggests that age is important in stroke unit rehabilitation, not only as an independent variable but also because it can determine the level of multidisciplinary rehabilitation input available to stroke patients not managed on the stroke unit. The benefits of stroke units in hastening functional recovery regardless of age without increased therapy time have been demonstrated (Chapter 8). The psychological advantages of quicker recovery and the support provided to patients and carers on the stroke unit in any age group cannot be overestimated. These units, hence, are an important management option for stroke patients in any age group.

CHAPTER 10. GENERAL CONCLUSIONS

10.1 OBJECTIVES OF THE THESIS

This series of investigations was undertaken to achieve two major objectives. The first major objective was to develop a system of assessment and data collection using standardised measures in stroke. The second major theme focused on the use of these measures in the evaluation of stroke rehabilitation in different settings and in different groups of patients.

10.1.1 Measures in stroke rehabilitation:

The initial objective of standardising prognostic classification, multidisciplinary assessments and outcome measures in stroke rehabilitation was achieved by a series of studies aimed at:

1) Reviewing and further describing clinical determinants of stroke outcome in older patients, a group widely ignored in studies on the natural history of stroke (Chapter 4).

2) Development and preliminary validation of a simple bedside prognostic score which could facilitate stratification of stroke patients for rehabilitation research (Chapters 5 & 6).

3) Development of an integrated "minimum" multidisciplinary assessment and outcome dataset for stroke rehabilitation using well-validated simple measures (Chapter 2).

10.1.1.1 Clinical determinants of outcome

There are numerous studies describing clinical determinants of stroke outcome which can be used for prognostication (Chapter 1). Most of these, however, were derived in selected populations of relatively young stroke patients and may have limited applicability to the majority of older stroke patients (Chapters 1 & 4). Hence, an unselected population of hospitalised stroke patients of appropriately advanced age (over 75 years) was studied (Chapter 4) to ascertain the validity of previously-known determinants in older stroke patients and to identify new prognostic indicators specific to this group. Results showed that most of the known clinical prognostic indicators were equally applicable but, in contrast to studies in relatively younger patients, dementia was shown to be an additional significant determinant of outcome in older stroke patients (Chapter 4).

10.1.1.2 Stratification according to prognosis

Results of stroke trials have been difficult to interpret because of the considerable variation in patient selection criteria in these studies (Chapter 1). Despite the known heterogeneity of stroke patients and expected differences in functional outcome, few studies have standardised intervention and control groups according to prognostic expectations (Chapter 1). This has been largely due to the lack of a simple, reliable and satisfactory system of prognostication which can be applied early in the course of rehabilitation (Chapters 1, 5 & 6). The development of a standardised system for reliable stratification of stroke patients undergoing rehabilitation was undertaken as a part of this thesis.

a) Derivation of prognostic criteria

A validated existing prognostic scale (Edinburgh Prognostic Scale) was available which included most of the important prognostic clinical determinants of rehabilitation outcome identified in the older patient group studied (Chapter 4). This scale was modified to include a measure of cognition and the modified scale (Orpington Prognostic Score) was evaluated in 64 patients (Chapter 5). Results showed that the modified score measured 2 weeks post-stroke was useful in predicting rehabilitation outcome in older stroke patients and could help in selecting those most likely to benefit from stroke unit rehabilitation (Chapter 5). Patients with Orpington Score <3 had mild strokes and were discharged within 3 weeks of stroke whereas those scoring >5 had very severe disability and required long-term care. Most patients with Orpington Score of 3-5 had moderate to severe disability and were discharged home after a period of rehabilitation although this was not always apparent at the time of hospital admission.

b) Validation of prognostic stratification

The development of any new scale brings with it the problems of validation. Multivariate scales have been criticised because of lack of validatory studies, especially in data-sets other than those in which they were derived (Chapters 1 & 6). In addition, it is important to demonstrate that any new scale has advantages over pre-existing scoring systems (Chapters 1 & 6). The Orpington Prognostic Score (OPS) was demonstrated to have greater predictive value than either the Edinburgh Prognostic Score or the Barthel ADL index measured at the same time (Chapter 5). In a further study in 217 patients, none of whom had participated in the study on the derivation of the prognostic score, the ability of OPS to stratify patients reliably according to expected outcome was further confirmed (Chapter 6). The score was comparable with urinary incontinence for sensitivity (96% v 90%), specificity (36% v 39%) and accuracy (75% v 66%) in identifying stroke patients achieving independent living. OPS had a greater

predictive value than urinary incontinence in identifying patients requiring institutional care (82% v 57%). Another advantage of the OPS was its ability to predict outcome at 2 weeks compared with 4 weeks recommended for urinary incontinence (Barer & Mitchell,1989; Gladman, Harwood & Barer,1992; Wade,1993c).

These studies supported the use of the Orpington Prognostic Score as a satisfactory method of stratifying stroke patients undergoing rehabilitation. Stratification according to prognostic expectations will allow broad homogeneity within each category and a better definition of patient groups participating in rehabilitation trials. This should facilitate better interpretation of results of studies evaluating therapy or service interventions and also allow comparisons between different settings where the prognostic composition of study groups is likely to be dissimilar because of service or other considerations.

10.1.1.3 Reliable data-collection

The quantity, quality, variability and reliability of data collection has been another area of concern in stroke studies (Chapter 1). This has prompted the British Stroke Research Group (1988) to propose a set of assessments in stroke which would constitute a common database for stroke management and comparisons between different stroke interventions (Chapter 1). The recommended assessments have failed to become universal in mainstream clinical practice, partly because of the large number still included in the minimum data-set and partly because of failure to evaluate the applicability and acceptability of these assessments prospectively in clinical practice. Another objective of this study was to develop a simple set of measures based on pre-existing and recommended assessments in stroke and to evaluate their applicability to clinical practice.

a) Development of an integrated system

The main considerations central to the development of the rehabilitation assessment dataset used in these studies were:

1) Achieving the objectives of the assessment process. These were identified as being prognostication, evaluation of deficits, monitoring of progress and measuring outcome (Chapter 1).

2) Ensuring the validity and adequacy of the chosen assessments to measure important aspects of stroke rehabilitation. This was achieved by a clear understanding of what information was wanted and for what purposes, limiting assessments to the minimum required to obtain this information and using existing validated measures wherever possible.

To be effective, all assessments undertaken on stroke patients needed to be available to the multidisciplinary team and to be close to the site where patients were being managed. This was achieved by the development of a computerised multidisciplinary stroke assessment system which was piloted on the stroke unit (Chapter 2). The system collected demographic data as well as medical, nursing, physiotherapy, occupational therapy, speech therapy and social assessments. Selected assessments in each major area of stroke rehabilitation were included in the battery and each professional was required to enter their speciality data at the time of assessment as a part of their routine work (Chapter 2). Results of the pilot evaluation showed that it was possible to introduce a computerised multidisciplinary assessment system on rehabilitation wards as a part of day-to-day work without the need for significant extra resources. The user survey showed confidence in using the system and an increase in frequency of use with time. The increase in workload, estimated at 15-60 minutes per week, was considered to be balanced by benefits in patient care, audit and research (Chapter 2). A "snapshot" of data entry showed a high degree of completeness (>90%) and accuracy (>95%) of data compared with conventional records (Chapter 2).

The applicability and adequacy of the basket of assessments comprising

the "minimum" dataset included in the integrated system was confirmed in subsequent studies undertaken to evaluate the effectiveness of a stroke rehabilitation strategy (Chapters 7, 8, 9).

b) Measuring the process of stroke rehabilitation

The measurement of the process of stroke rehabilitation, especially the measurement of therapy intervention, presents significant problems. There is considerable controversy on the definitions of different types of therapy input, the role of specific therapy strategies and the overall contribution of therapy to stroke rehabilitation (Chapter 1). Even within therapists, there is little agreement on how therapy input should be measured (quantity) as well as on which specific areas or therapy techniques are important and need to be measured (quality).

A preliminary attempt to measure therapy input was made in this study. It was decided to concentrate upon physiotherapy and occupational therapy, both of which are important therapy interventions and available in most settings in which stroke is managed (Chapter 7). In the absence of accepted measures of physiotherapy and occupational therapy input, arbitrary measures were defined in consultation with the therapists. These included measuring the duration and type of therapy given to individual stroke patients which were recorded by therapists working with the patients (Chapter 7). It is important to emphasise that the process measures of therapy used in these studies were arbitrary and there is an urgent need for individual disciplines to reach a consensus on standardising measures of therapy input. These studies show that measurement of therapy intervention is possible and inclusion of therapy details in rehabilitation studies allows more meaningful interpretation of results.

Measuring outcome also presents problems in stroke research as a "good" outcome varies with the perception of the observer (Chapter 1). Results of studies undertaken in the thesis suggest that no single measure would have been adequate to judge outcome (Chapters 6-9). Hence, a range of outcome measures including mortality,

destination of discharge, functional status at discharge and length of hospital stay have been used (Chapters 3-9). It appeared that mortality, destination of discharge and Barthel index at discharge reflected the quality of care and the outcome of therapy input, whereas the length of hospital stay was a surrogate measure for the cost-effectiveness of the whole rehabilitation process.

Studies undertaken in this thesis have shown the feasibility and advantages of integrated data collection in stroke. Such data is essential, not only for research purposes, but also for service development (needs assessment and strategic planning) and evaluating the effectiveness of stroke rehabilitation in any setting (audit and quality assurance).

10.1.2 Effectiveness of a stroke rehabilitation unit

The second major objective of these investigations was to use the prognostic stratification and data collection techniques developed to evaluate the effectiveness of a stroke rehabilitation unit. A prospective randomised controlled study was undertaken in 245 stroke survivors at 2 weeks which represented 97% recruitment from the 252 eligible patients (Chapter 7).

a) Comparison with general wards

An overall comparison between the stroke rehabilitation unit and general medical wards showed that patients with intermediate prognosis managed on the stroke unit had significantly better outcome with more patients being discharged home, shorter average length of hospital stay and better functional abilities at discharge (Chapter 7). These were achieved without any significant increase in therapy time. Patients with poor prognosis managed on general wards showed significantly longer hospital stays

but functional abilities at discharge in survivors were comparable with the stroke unit. Functional abilities at discharge, destination of discharge and length of hospital stay in patients with good prognosis were comparable in both settings. These data confirm the advantages of patient selection according to prognosis based on OPS criteria.

b) Speed of functional recovery

Shorter lengths of hospital stay on stroke units could be due to quicker functional recovery or mechanisms of expediting discharge from hospital (Chapter 8). Median discharge Barthel index of patients managed on the stroke unit was significantly higher than that of patients managed on general wards. Median Barthel index in the stroke unit group rose rapidly after 2 weeks reaching a plateau at median discharge Barthel index at 6 weeks. The change in median Barthel index in patients on general wards was significantly slower, reaching a plateau at 12 weeks despite similar therapy input. There was a significant delay in discharging stroke patients on general wards (20 weeks) compared with the stroke unit (6 weeks). This suggested that functional recovery was significantly greater and more rapid on a stroke rehabilitation unit despite similar therapy input (Chapter 8). A mechanism for expediting appropriate discharges also was shown to exist on the stroke unit.

c) Effect of age group on stroke rehabilitation

Several studies have suggested a negative correlation between age and stroke outcome (Chapter 1). The question of age becomes particularly important in Britain because of the development of geriatric services in the country. In most districts with a well-developed geriatric service, it is likely that older stroke patients cared for by the service will benefit from multidisciplinary input from the very beginning of their illness and be supported by well-developed systems within the community following discharge from hospital. The availability of similar facilities was limited for younger

stroke patients during the study period because of age thresholds in provision of care in the community which existed at the time of the study. Such differences are likely to influence outcome in different age groups and have significant implications in developing management strategies for stroke patients (Chapter 9).

Analysis of data using age as the major discriminant showed that younger stroke patients benefited more by stroke unit rehabilitation compared with older patients, not only because of their age but also because of differences in the level of multidisciplinary input available to elderly patients outside the stroke unit (Chapter 9). The therapy input provided to elderly patients on geriatric medical wards was similar to that on the stroke unit, probably because of the well-developed multidisciplinary philosophy on these wards (Chapter 9). Not surprisingly, functional outcome in older stroke patients was similar in both settings except for a shorter median length of hospital stay on the stroke unit. Outcome in younger patients managed on general wards, in contrast, was worse than that in older patients with similar prognostic expectations managed on geriatric wards, highlighting the limitations of acute medical wards to provide for the rehabilitation needs of stroke patients.

These studies have demonstrated clear and measurable benefits of a stroke rehabilitation unit. The advantage of patient selection, i.e. targeting specialist therapy resources towards stroke patients most likely to benefit from this input, was also demonstrated. Although there can be several ways to select patients for specialist input, the usefulness of the Orpington Prognostic Score as a method of targeting input was confirmed.

The relative benefits of stroke unit rehabilitation appear to be greater in younger stroke patients. This is not because of poor "response" to intensive intervention in older stroke patients but because of better alternatives and management systems available on geriatric medical wards. It is likely that the age differences in stroke unit rehabilitation would be reduced if a rehabilitation philosophy were to be introduced on general medical wards.

The mechanism by which the stroke unit improved outcome appeared to be a combination of quicker recovery due to targeted therapy, realistic goal setting and early mobilisation of appropriate resources to expedite discharge from hospital. The contribution of positive attitudes amongst therapists and nursing staff, involvement of families and the psychological impact of being in a specialist situation (the concept of a "therapeutic community") cannot be measured easily but may have contributed significantly to the overall benefits of stroke unit rehabilitation.

10.2 MEASURES TO EVALUATE STROKE REHABILITATION

The work undertaken in the thesis has enabled the proposal of a set of realistic measures to evaluate and compare stroke rehabilitation in different settings. The assessments which may be useful in stroke rehabilitation are:

10.2.1 Assessments in patient care

On Admission:

1) Patient and admission details.

demographic details

details of accommodation

previous need and availability of family/community support

2) Medical examination and stroke risk evaluation

(based on the Royal College of Physicians Stroke Audit criteria).

type of stroke

anatomical localisation

extent & severity of neurological deficit

details of previous cerebrovascular disease

co-morbidity and additional impairments

stroke risk factors and their management

need for intervention for secondary stroke prevention

3) Orpington Prognostic Score

4) Hodkinson Mental Test Score

5) Premorbid Frenchay Activities Index

6) Barthel Activities of Daily Living Index

7) Rivermead Perceptual Assessment Battery, if applicable

8) Motoricity Index

9) Functional Ambulation Categories

10) Frenchay Aphasia Screening Test

11) Assessment of swallowing

12) Hospital Anxiety and Depression Scale

Weekly monitoring:

1) Motoricity Index

2) Functional Ambulation Categories

3) Barthel ADL Index

At discharge:

1) Barthel ADL Index

2) Motoricity Index

3) Functional Ambulation Categories

4) Rivermead Battery, if undertaken on admission

5) Mental Test Score (if impaired on admission)

Long-term:

These should be undertaken six months after stroke (Wade,1992c; Lincoln,1992):

1) Rankin Scale

2) Frenchay Activities Index

3) Institutionalisation

4) Nottingham Health Profile (Ebrahim, Barer & Nouri,1986)

10.2.2 Measurement of effectiveness of stroke services

The measures common to assessing the effectiveness of stroke services are (Chapter 2):

1) Number of patients eligible who actually receive the service

2) Duration between:

stroke and referral

referral and assessment

assessment and provision of service

3) Mortality

4) Institutionalisation rate

5) Percentage of patients discharged home

6) Length of hospital stay

10.2.3 Measurement of stroke unit functioning

New measures have been proposed as a result of this study which may be specific to assessing the functioning of stroke units (Chapter 9). The suggested measures (which need to be applied to patient groups of comparable deficits and prognosis) are:

1) the median discharge Barthel index (measure of the extent of functional recovery in the setting).

2) time required by the patient group to achieve this index (measure of the rate of functional recovery in the setting).

3) time required to discharge the remaining stroke patients once the group achieves the median discharge Barthel index (measure of mechanisms to expedite discharges from the setting).

4) the rate of decrease of median Barthel index of patients remaining on the unit after median Barthel index is achieved (measure of appropriateness of discharges from the setting).

Assessments in each category represent the minimum amount of information that needs to be collected on stroke patients undergoing rehabilitation. The burden of assessing patients was reduced in our setting by designating professionals who carried out specific assessments and by sharing all assessments within the multidisciplinary team. It may be necessary to undertake other assessments for specific deficits on initial evaluation, or repeat some assessments (e.g. mental test score, swallowing assessments) more often if indicated by clinical needs.

The need to develop a "common language" for assessments has been discussed in detail in earlier chapters (Chapters 1 & 2). The assessments proposed above have been successfully used in the series of investigations undertaken and have been shown to be useful and practicable. They are, hence, recommended for wider use.

10.3 SERVICE IMPLICATIONS

A major dilemma facing the NHS is that of providing free, comprehensive and effective care which is equally accessible to all with only finite resources (Cochrane,1972). Given the financial limitations, it is recommended that:

1) Only those forms of care which research has clearly shown to be beneficial should be offered by the NHS.

2) The randomised controlled trial is the form of research most likely to determine whether or not a particular treatment is effective.

(Cochrane,1972)

It is also important that local research is applied to local clinical practice in order to improve the effectiveness of local services (Fig 10.1). The benefits of stroke unit rehabilitation over conventional management on general wards were clearly demonstrated in Bromley and this has resulted in the integration of stroke unit rehabilitation into mainstream patient care within the local service.

Targeting of therapy and resource input is another important consideration in maximising the effectiveness of any intervention. Although it would be inconceivable to deny any stroke patient adequate treatment solely on the basis of severity of disability, there may be advantages both for the patient and the hospital service in directing specialist resources towards patients most likely to benefit from such input. Targeting criteria should be suggested by clinical experience, derived from retrospective sub-group analysis and confirmed by prospective evaluation. To be effective, targeting needs to be objective, easily administered, inexpensive and not require specialist resources.

OPS has been demonstrated to have these attributes and can help in identifying the "middle group" of stroke patients who are most likely to benefit from stroke unit rehabilitation (Chapters 6 & 7). OPS facilitates "positive" selection as early as 1 week but delays "negative" selection as late as 4 weeks so that stroke patients who may have slower recovery are not disadvantaged. The scoring system has been introduced as an objective method of selecting patients for stroke unit rehabilitation and

has allowed more appropriate resource usage with realistic goal setting and timely intervention. The clinical use of the score is being continually monitored by regular audit and review.

Overall, the studies undertaken as a part of this thesis have resulted in the development of a coherent philosophy for stroke management locally which is recognised by the commissioners and providers of health care. The hospital provider unit has benefited by being able to provide a better service for stroke patients with improved bed-utilisation and little add-on costs. Patient satisfaction surveys undertaken at the time of discharge and 6 months post-discharge show a high level of satisfaction with the services provided.

Studies on health delivery systems should not be seen in isolation from mainstream clinical practice but need to be incorporated into wider strategies for providing health care. Studies in this thesis provide the framework for a "shared-care" model of stroke care which will ensure uniform standards of care across a range of hospital and community settings. Overall services will be coordinated by the existing stroke service in collaboration with local general practitioners, statutory and voluntary agencies and patients and their families. The emphasis will be on prevention of stroke and providing "seamless" care over specialist areas of interest as well as over time from acute episode to long-term management. This model is in line with the current philosophy of health care provision (Health of the Nation, Care in the Community) and has been incorporated in the strategic plans of Bromley Health Commissioners.

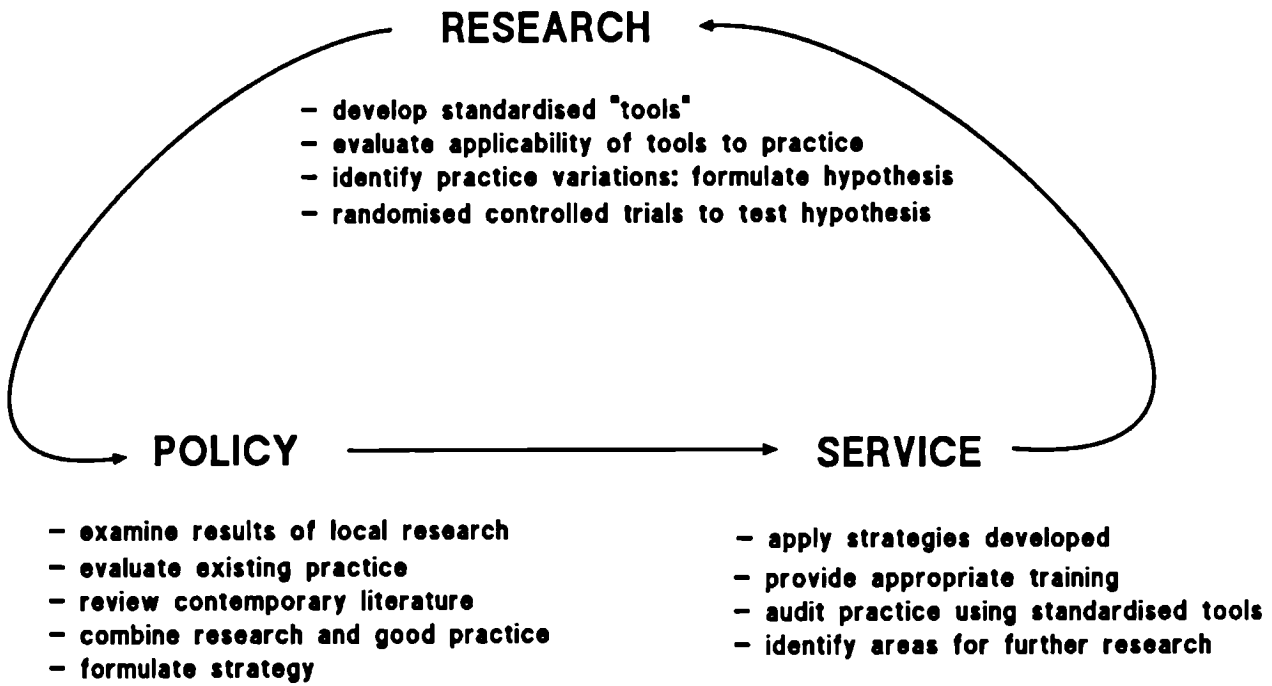


Fig 10.1 The research–policy–service cycle

10.4 SUGGESTIONS FOR FUTURE RESEARCH

10.4.1 Strategies in service provision

A standardised framework for the organisation of stroke rehabilitation and for the measurement of prognosis, intervention and outcome has obvious applications to future research. These studies provide the background and framework to undertake further work in evaluating service strategies in stroke management. In particular, the essential (and historically deficient) requirements for valid controlled intervention studies are fully in place and projects currently being undertaken on the unit are aimed at:

1) assessment of the wider applicability of the methodology to stroke population samples in other centres, with further validation of the "minimum" dataset in stroke rehabilitation.

2) comparison of patient heterogeneity, process and outcome of stroke care in different settings to assess whether differences in outcome relate to differences in clinical practice.

This is being facilitated by:

a) A two-centre study in collaboration with the Canterbury stroke unit using similar patient selection, assessment and outcome criteria to compare case-mix, clinical practice and outcome. In contrast to the previous randomised controlled study, outcome is being assessed at discharge and 6 months after stroke. A psychosocial component looking at quality of life and carer factors has been included in the outcome measures.

b) A comparison between a community-based acute stroke team and the stroke unit using the methodology developed. The objectives of the community stroke team are to manage acute stroke patients at home and provide a full range of medical, nursing and therapy services. The standard of care provided, outcome and costs will be compared between the two settings.

These studies should result in:

1) Identification of processes and practices which may be associated with improved outcome or with cost effective management strategies. These can be tested in large multicentre randomised controlled trials (Cochrane's Agenda).

2) Modification of the set of assessments to encompass variations in practice for wider use in stroke rehabilitation. It is anticipated that the amount of data collected and the variety of settings in which stroke rehabilitation was assessed will establish the validity of the assessment used for wider application throughout the NHS. The work also should enable a set of realistic markers of quality to be proposed against which existing and new services can be evaluated.

Other studies which will be of significant interest in this area include:

1) Evaluation of the impact of community based rehabilitation services on stroke management. Recent years have seen an emphasis on shifting the focus of stroke management away from hospitals and towards the community. Several studies have shown better outcomes with domiciliary management compared with conventional hospital care (Chapter 1). Most studies, however, have compared intensive interventions in the community with conventional care in hospitals which was usually inadequate or inappropriate. A comparison of the cost-effectiveness of an intensive community based rehabilitation programme with stroke unit rehabilitation will be of great interest and support has been negotiated for this work. Similarly the benefits of continuing community-based rehabilitation following discharge from hospital stroke units require evaluation.

2) Geographically defined stroke units are expensive and have limited capacity which may lead to problems of access. It may be possible to resolve these problems by developing stroke teams which advise on management throughout the hospital or even in the community (Chapter 1). The feasibility and cost-effectiveness of stroke teams needs evaluation against stroke unit or community based rehabilitation. These studies will also allow the identification of patient groups who could benefit from different strategies of stroke management.

3) Acute stroke units are gaining increasing popularity but their effectiveness in patient care remains questionable (Chapter 1). Collaboration or integration between acute and rehabilitation stroke units may have advantages in patient care and improve outcome in stroke patients. There are no studies available on this aspect of service organisation and a systematic evaluation is needed in the near future.

10.4.2 Development of stroke practice

The impact of various therapy and nursing practices in stroke is largely anecdotal. There is an urgent need for the systemic development of practice based on scientific evaluation of specific techniques and interventions. A stroke unit provides the ideal situation to undertake such investigations. The results of novel interventions are likely to affect several modalities of impairment or disability and the difficulties in accurately defining discrete effects of therapy intervention are well-known (Chapter 1). The use of an integrated assessments database which has common measures and to which new assessments can be added should allow such effects to be detected, even if these were not within the direct scope of the intervention discipline. A number of controlled studies on therapy and nursing interventions are being currently undertaken on the unit at Orpington.

Results on stroke unit rehabilitation suggest that approximately 20% of patients with severe disability are discharged home (Chapter 7). Further studies aimed at

ascertaining clinical determinants which can reliably identify this subgroup of patients early in the course of the disease will be helpful in refining the patient selection process. The stroke unit also offers a focus for developing specialist skills for managing severely disabled stroke patients. It may be possible to achieve a higher percentage of home discharges in this group of patients despite poor functional recovery by focused rehabilitation techniques, early social services intervention, closer liaison with families and more innovative care packages to support discharges. This needs to be evaluated using carefully controlled studies.

10.4.3 Recovery from stroke

Little is known about the patterns of recovery from stroke and how these are influenced by rehabilitation. For example, the pattern and basis of neurological recovery is largely unknown, although recent papers suggest reactivation of silent areas in the brain (Chapter 1). The availability of sophisticated investigation techniques such as positron emission tomography (PET) will enable the process of activation of the brain during recovery as well as the central effects of any medical or therapy intervention undertaken to be measured in stroke patients. This will help in developing a rational basis for providing stroke rehabilitation tailored to the type of impairment or disability.

The reason why some stroke patients recover late or show stepwise recovery is not known. The ability to document impairments and disabilities using a standardised assessment format and over a period of time and in patients stratified according to prognosis will clarify relationship between neurological and functional recovery patterns and patient characteristics. This will facilitate the identification of patients likely to have slow recovery so that they are not disadvantaged by negative selection for rehabilitation early in the course of their illness. The possibility of influencing patterns of recovery by pharmacological and non-pharmacological means (eg. group therapy, amphetamines, antidepressants) also needs to be studied. Similarly, the individual contributions of intrinsic and adaptive mechanisms to overall recovery and

the extent to which these are affected by specific therapy techniques or drugs need to be assessed.

Another possible area of investigation is that of recovery in various stroke sub-populations. The effects of age and prognostic expectations have been presented in this thesis. Further work is required to examine the effects of specific deficits and comorbidity (eg. generalised atherosclerosis, dementia, diabetes, arthritis) which may accompany stroke.

10.4.4 Integrated assessments

The role of integrated assessments in stroke rehabilitation has been demonstrated in this thesis. It is likely that other chronic illnesses requiring rehabilitation will benefit from a similar approach. It would be of interest to study the application of similar integrated systems comprising relevant assessments to the management of neurological disorders such as Parkinson's disease, multiple sclerosis or motor neurone disease and in non-neurological settings for management of disorders such as rheumatoid arthritis and seronegative arthropathies.

10.5 FINAL CONCLUSIONS

To conclude, findings in this thesis, as in other areas of developing technology, confirm the value and importance of ensuring access for people of all ages to specialist care and sophisticated techniques. The role of standardised integrated assessments in stroke and their applications in stroke research has also been presented. Stroke patients are a heterogeneous group, with complex and sometimes devastating problems. Recovery patterns are variable and, often, unpredictable. Precise definition, accurate measures and the evaluation of one major rehabilitation strategy at a time will yield slow but reliable answers. The alternative is a continuous and costly quandary (Hachinski,1989).

It also needs to be remembered that different interventions in stroke management may not only produce differing outcomes (as shown in these studies) but may also have different resource implications to various agencies involved in providing care to stroke patients. It is quite possible that quicker discharge of more disabled patients may be seen as being cost-effective for hospitals but may result in significant health or social services resource utilisation in the community. It is, hence, important to evaluate the relationship between resource use, cost and outcome of different stroke strategies to all providers of service across the hospital community interface to facilitate informed decision making in the purchasing of health care. Such an evaluation was not possible in these studies because of their preliminary nature, resource limitations and the need to prove effectiveness prior to undertaking a more detailed and expensive evaluation. A study on the cost-effectiveness of alternate strategies of stroke rehabilitation is now being planned with the Personal Social Services Research Unit at Canterbury which will commence in the near future.

Appendix I: Raw data

Table 1.1a. Orpington stroke management system user survey in 13 prime users on the stroke rehabilitation unit at the beginning of the 6 month pilot evaluation period (Chapter 2).

User	Prof.	dur.	freq	time	confid.	instr	train	work	MDPC	Audit	Res	Dx sum
1	DOC	3	2	2	1	1	1	1	1	1	1	1
2	DOC	1	2	3	1	1	1	2	0	1	0	1
3	NUR	2	1	2	0	1	1	2	1	1	0	1
4	NUR	2	1	3	0	1	1	2	0	0	0	0
5	NUR	2	1	3	1	1	0	3	0	1	0	1
6	NUR	1	2	3	1	1	1	4	0	0	0	0
7	NUR	3	1	3	0	1	1	3	1	0	0	0
8	NUR	2	1	2	0	1	0	4	0	0	0	1
9	NUR	2	2	3	1	1	1	3	0	0	0	0
10	PT	2	2	3	0	1	1	3	1	0	0	0
11	PT	1	1	2	1	1	1	4	0	0	0	1
12	OT	2	2	3	1	1	1	3	1	0	0	1
13	OT	2	1	2	0	1	1	4	0	0	0	1

Table 1.1b. Orpington stroke management system user survey in 13 prime users on the stroke rehabilitation unit at the end of the 6 month pilot evaluation period.

User	Prof.	dur.	freq	time	confid.	instr	work	MDPC	Audit	Res	Dx sum
1	DOC	3	2	1	1	1	1	1	1	1	1
2	DOC	3	3	2	1	1	2	1	1	0	1
3	NUR	3	2	1	1	1	2	1	1	1	1
4	NUR	3	3	2	1	1	2	1	0	0	1
5	NUR	3	2	3	1	1	3	0	1	1	1
6	NUR	3	2	1	1	1	3	1	1	0	1
7	NUR	3	2	2	1	1	2	1	1	1	1
8	NUR	3	2	2	1	1	3	1	0	0	1
9	NUR	3	3	1	1	1	2	1	0	0	1
10	PT	3	3	2	1	1	3	1	1	0	0
11	PT	3	2	1	1	1	3	0	1	0	1
12	OT	3	3	1	1	1	2	1	1	1	1
13	OT	3	3	2	1	1	3	1	0	1	1

Prof.: Profession; DOC: doctor; NUR: nurse; PT: Physitherapist; OT: Occupational therapist;
dur: duration of use - 1: <1 month; 2: 1-3 months; 3: > 3 months;
freq: frequency of use - 1: <1 time/week; 2: 1-2 times/week; 3: >2 times/week;
time: time spent per session - 1: <15 mins; 2: 15-30 mins; 3: >30 mins
confid.: confidence in data entry - 0: not confident; 1: confident;
instr: adequate "on-screen" instructions - 0: inadequate; 1: adequate;
train: training mode helpful - 0: not helpful; 1: helpful;
work: increase in workload - 1: <15 mins/week; 2:15-30 mins/wk; 3: 30-60 mins/wk; 4: >60 mins/week;
MDPC: multidisciplinary patient care - 0: not helpful; 1:helpful;
Audit - 0: not helpful; 1:helpful;
Res: research - 0: not helpful; 1: helpful;
Dx sum: discharge summaries - 0: not helpful; 1: helpful.

Table 1.2a. Comparison of computer database for data entered by doctors and nurses (patient details, medical assessments and premorbid function) with conventional records for number of errors and accuracy of data entry in the 67 patients registered during the pilot evaluation period (Chapter 2).

Pt No.	patient file		in pt. records		Frenchay Index		med. record	
	No.	remarks	No.	remarks	No.	remarks	No.	remarks
1	1	no error	1	no error	1	no error	1	no error
2	1	no n.o.k.	1	no error	1	no error	1	no error
3	1	no error	1	no error	1	no error	1	no error
4	1	no error	1	no error	0	no conv. rec.	2	duplicate
5	1	no error	1	no error	1	no error	1	no error
6	1	no error	1	no error	1	no error	1	no error
7	1	no error	1	no error	1	no error	0	conv. rec.
8	1	no error	1	no error	1	no error	1	no error
9	1	no n.o.k.	1	no error	1	no error	1	no error
10	1	no error	1	no error	1	no error	1	no error
11	1	no error	1	no error	1	no error	1	no error
12	1	no error	1	no error	1	no error	1	no error
13	1	no error	1	no error	1	no error	1	no error
14	1	no error	2	dupilcate	1	no error	1	no error
15	1	incomplete	1	no error	1	no error	1	no error
16	1	code 99	1	no error	1	no error	1	no error
17	1	no error	1	no error	1	no error	1	no error
18	1	no error	2	ab. dates	1	no error	2	reassess
19	1	no error	1	no error	1	no error	1	no error
20	1	no error	1	no error	1	no error	1	no error
21	1	no error	1	no error	1	no error	0	conv. rec.
22	1	no error	1	no error	1	no error	1	no error
23	1	no n.o.k.	1	no error	1	no error	1	no error
24	1	no error	1	no error	1	no error	1	no error
25	1	no error	2	ad. x 2	2	ad. x 2	2	ad. x 2
26	1	no error	1	no error	1	no error	1	no error
27	1	no address	1	no error	1	no error	1	no error
28	1	no error	1	no error	1	no error	1	no error
29	1	no error	1	no error	1	no error	1	no error
30	1	no error	2	no error	1	no error	1	no error
31	1	no n.o.k.	1	no error	1	no error	2	duplicate
32	1	no error	1	no error	1	no error	1	no error
33	1	no error	1	no error	1	no error	1	no error
34	1	no error	1	no error	1	no error	1	no error
35	1	no error	1	ab. dates	1	no error	0	conv. rec.
36	1	no error	1	no error	1	no error	1	no error
37	1	no error	1	no error	1	no error	1	no error
38	1	no n.o.k.	1	no error	1	no error	1	no error
39	1	no error	1	no error	0	no conv. rec.	1	no error
40	1	no error	1	no error	1	no error	2	duplicate
41	1	no error	1	no error	1	no error	1	no error
42	1	no error	1	no error	1	no error	1	no error
43	1	no n.o.k.	1	no error	1	no error	1	no error
44	1	no error	1	no error	1	no error	0	conv. rec.
45	1	code 99	1	no error	1	no error	1	no error
46	1	no error	1	no error	1	no error	1	no error
47	1	no error	1	no error	1	no error	1	no error
48	2	duplicate	1	no error	1	no error	2	duplicate
49	1	no error	1	no error	1	no error	1	no error
50	1	temp add.	1	no error	1	no error	1	no error

Table 1.2a contd/

Table 1.2a (contd). Comparison of computer database for data entered by doctors and nurses (patient details, medical assessments and premorbid function) with conventional records for number of errors and accuracy of data entry in the 67 patients registered during the pilot evaluation period (Chapter 2).

Pt No.	patient file		in pt. records		Frenchay Index		med. record	
	No.	remarks	No.	remarks	No.	remarks	No.	remarks
51	1	no error	1	no error	1	no error	1	no error
52	1	no error	1	no error	1	no error	1	no error
53	1	no error	1	no error	2	duplicate	0	conv. rec.
54	1	no error	1	no error	1	no error	1	no error
55	1	no error	1	2 ad., 1 rec*	1	no error	1	no error
56	1	no n.o.k	1	no error	1	no error	1	no error
57	1	no error	1	no error	1	no error	1	no error
58	1	code 99	1	no error	1	no error	1	no error
59	1	no error	1	no error	1	no error	0	conv. rec.
60	1	no error	1	no error	1	no error	1	no error
61	1	no error	1	ab. dates	1	no error	1	no error
62	1	no error	1	no error	1	no error	1	no error
63	1	no n.o.k	1	no error	1	no error	1	no error
64	1	no error	1	no error	1	no error	1	no error
65	1	no error	1	no error	1	no error	1	no error
66	1	code 99	1	no error	1	no error	0	conv. rec.
67	1	no error	1	no error	1	no error	1	no error

0: no computer entry; 1: one entry on database; 2: two entries on database;

in pt. records: in-patient records; med. record: medical records; n.o.k.: next of kin; code 99: place of admission miscoded; duplicate: unneccary duplicate entries; ab. date: dates for events between stroke and transfer to the unit not entered on computer; ad.: admissions; rec.: record; reassess: duplication due to reassessment. conv. rec.: conventional records present; temp add.: wrong temporary address.

* Patient had 2 admissions due to stroke but only one record was found on database.

Table 1.2b. Comparison of computer database for data entered by occupational therapists (Barthel assessments) with conventional records for number of errors and accuracy of data entry in the 67 patients registered during the pilot evaluation period (Chapter 2).

Pt No.	Ad. BADL		Dx BADL		pos.	Actual record	
	comp	conv	comp	conv	ass.	conv	comp
1	6	6	17	17	3	3	3
2	2	2	9	9	3	3	3
3	8	8	20	20	3	3	3
4	7	7	19	19	3	3	3
5	2	2	11	11	8	6	6
6	4	4	10	10	3	3	3
7	5	5	16	16	8	8	8
8	6	6	15	15	3	3	3
9	4	4	10	10	8	8	8
10	0	0	6	6	8	8	8
11	3	3	15	15	8	8	8
12	3	3	14	14	3	3	3
13	4	4	12	12	7	5	5
14	3	3	10	10	9	9	9
15	5	5	18	18	3	3	3
16	6	6	15	15	3	2	2
17	4	4	12	12	7	7	7
18	4	4	9	9	7	7	7
19	8	8	20	20	3	3	3
20	6	6	17	17	6	4	4
21	2	2	11	11	8	8	8
22	6	6	12	12	3	3	3
23	5	5	16	16	3	3	3
24	0	0	8	8	7	7	7
25	2	2	6	6	9	8	8
26	2	2	13	13	3	3	3
27	0	0	6	6	8	8	7
28	7	7	15	15	2	2	2
29	4	4	11	11	3	3	3
30	6	6	18	18	3	3	3
31	4	4	11	11	3	3	3
32	4	4	12	12	8	6	6
33	6	6	16	16	4	4	4
34	8	8	20	20	3	3	3
35	2	2	13	13	3	3	3
36	5	5	16	16	5	5	5
37	4	4	8	8	8	5	5
38	5	5	16	16	3	3	3
39	6	6	18	18	3	3	2
40	4	4	10	10	8	8	8
41	5	5	16	16	5	5	5
42	6	6	18	18	5	5	5
43	0	0	8	8	7	7	7
44	2	2	11	11	8	8	8
45	5	5	16	16	3	3	3
46	4	4	11	11	9	5	5
47	3	3	11	11	10	7	7
48	4	4	12	12	6	6	6
49	6	6	15	15	8	8	7
50	5	5	17	17	3	3	3

Table 1.2b (contd.)/

Table 1.2b (contd). Comparison of computer database for data entered by occupational therapists (Barthel assessments) with conventional records for number of errors and accuracy of data entry in the 67 patients registered during the pilot evaluation period (Chapter 2).

Pt No.	Ad. BADL		Dx BADL		pos.	Actual record	
	comp	conv	comp	conv	ass.	conv	comp
51	5	5	18	18	3	3	3
52	6	6	15	15	8	8	8
53	2	2	6	6	9	9	9
54	4	4	15	15	2	2	2
55	6	6	15	15	3	3	3
56	2	2	7	7	3	3	3
57	2	2	13	13	10	10	8
58	5	5	18	18	3	3	3
59	4	4	12	12	8	8	8
60	5	5	17	17	3	3	3
61	2	2	13	13	8	8	8
62	4	4	9	9	7	7	7
63	6	6	18	18	5	5	5
64	6	6	12	12	3	3	3
65	8	8	19	19	8	7	7
66	4	4	15	15	2	2	2
67	4	4	9	9	7	7	7

Ad. BADL: Admission Barthel ADL index; Dx BADL: Discharge BADL index; comp: computer database; conv: conventional data; pos. ass.: no of assessments possible excluding admission and discharge assessments.

Table 1.2c. Comparison of computer database for data entered by physiotherapists (Orpington Prognostic score [OPS], Functional Ambulation Categories [FAC]) with conventional records for number of errors and accuracy of data entry in the 67 patients registered during the pilot evaluation period (Chapter 2).

Pt No.	OPS		Admit. FAC		Disch. FAC		pos.	No. of ass.	
	comp	conv	comp	conv	comp	conv	ass.	conv	comp
1	4.8	4.8	0	0	3	3	3	1	1
2	5.6	5.6	0	0	2	2	3	2	2
3	4.2	4.2	0	0	3	3	3	3	3
4	5.6	5.6	0	0	2	2	3	2	2
5	4.4	4.4	0	0	3	3	8	4	4
6	4.8	4.8	1	1	3	3	3	3	3
7	4.8	4.8	1	1	4	4	8	2	2
8	4.4	4.4	1	1	4	4	3	3	3
9	3.6	3.6	0	0	3	3	8	6	6
10	3.6	3.6	2	2	4	4	8	2	2
11	3.2	3.2	1	1	3	3	8	4	4
12	2.4	2.4	3	3	4	4	3	3	3
13	4.8	4.8	0	0	2	2	7	7	7
14	4.0	4.0	0	0	3	3	9	9	9
15	2.8	2.8	1	1	4	4	3	3	3
16	5.6	5.6	1	1	4	4	3	2	2
17	3.6	3.6	2	2	4	4	7	7	7
18	5.6	5.6	0	0	0	0	7	6	6
19	2.4	2.4	0	0	2	2	3	3	3
20	4.8	4.8	0	0	3	3	6	6	6
21	4.4	4.4	2	2	5	5	8	8	8
22	5.2	5.2	0	0	0	0	3	2	2
23	3.2	3.2	1	1	4	4	3	3	3
24	4.4	4.4	0	0	3	3	7	7	7
25	5.6	5.6	1	1	3	3	9	7	7
26	3.6	3.6	0	0	3	3	3	3	3
27	2.0	2.0	1	1	4	4	8	6	6
28	3.2	3.2	0	0	2	2	2	2	2
29	4.0	4.0	1	1	3	3	3	3	3
30	4.0	4.0	1	1	4	4	3	3	3
31	5.6	5.6	1	1	4	4	3	3	3
32	2.4	2.4	0	0	3	3	8	8	8
33	5.2	5.2	0	0	2	2	4	4	4
34	5.2	5.2	1	1	4	4	3	3	3
35	2.8	2.8	1	1	3	3	3	3	3
36	3.6	3.6	1	1	4	4	5	5	5
37	2.0	2.0	1	1	4	4	8	5	5
38	4.4	4.4	1	1	2	2	3	3	3
39	2.8	2.8	1	1	4	4	3	3	3
40	6.4	6.4	0	0	1	1	8	8	8
41	6.8	6.8	0	0	0	0	5	5	5
42	2.8	2.8	1	1	4	4	5	3	3
43	3.2	3.2	0	0	3	3	7	7	7
44	4.4	4.4	0	0	2	2	8	8	8
45	3.2	3.2	0	0	2	2	3	2	2
46	5.6	5.6	1	1	4	4	9	9	9
47	4.8	4.8	0	0	2	2	10	6	6
48	4.8	4.8	0	0	2	2	6	6	6
49	3.2	3.2	0	0	2	2	8	8	8

Table 1.2c (contd.)/

Table 1.2c (contd). Comparison of computer database for data entered by physiotherapists (Orpington Prognostic score [OPS], Functional Ambulation Categories [FAC]) with conventional records for number of errors and accuracy of data entry in the 67 patients registered during the pilot evaluation period (Chapter 2).

Pt No.	OPS		Admit. FAC		Disch. FAC		pos.	No. of ass.	
	comp	conv	comp	conv	comp	conv	ass.	conv	comp
50	3.6	3.6	0	0	3	3	3	3	3
51	3.6	3.6	1	1	4	4	3	3	3
52	3.2	3.2	0	0	2	2	8	7	7
53	3.2	3.2	1	1	4	4	9	5	5
54	2.4	2.4	1	1	4	4	2	2	2
55	4.8	4.8	0	0	1	1	3	3	3
56	4.0	4.0	0	0	3	3	3	3	3
57	3.2	3.2	0	0	2	2	10	9	9
58	4.0	4.0	0	0	3	3	3	3	3
59	4.8	4.8	1	1	4	4	8	8	8
60	4.0	4.0	0	0	2	2	3	3	3
61	4.8	4.8	0	0	3	3	8	8	8
62	4.4	4.4	0	0	3	3	7	7	7
63	4.8	4.8	2	2	4	4	5	5	5
64	4.0	4.0	0	0	3	3	3	3	3
65	3.2	3.2	1	1	4	4	8	8	8
66	4.4	4.4	0	0	3	3	2	2	2
67	4.4	4.4	2	2	4	4	7	5	5

Admit.: Admission; Disch.: Discharge; comp: computer database; conv: conventional records; pos. ass.: maximum possible assessments; No. of ass.: Actual number of assessments.

Table 2.1. Basic demographic data including patient characteristics, lengths of hospital stay and outcome in 96 elderly (age >75 years) stroke patients included in the study on determinants of stroke outcome in the elderly (Chapters 4 & 5).

Pt No.	Age yrs	Sex	Prev. Str.	Demen.	Prev. Res.	Status	Pre.BADL	Outcome	LOS days
1	76	M	N	N	1	1	20	1	12
2	82	F	N	N	1	1	20	1	71
3	77	F	N	N	1	1	20	0	13
4	76	F	N	Y	1	2	19	0	1
5	88	F	N	N	1	1 +	14	1	19
6	79	F	N	N	1	1	20	2	172
7	81	F	N	N	1	1	20	0	72
8	89	F	N	N	1	2	20	1	7
9	79	M	Y	Y	2	-	7	0	2
10	76	M	N	N	1	1	20	1	32
11	91	F	N	N	1	2	20	1	11
12	88	M	N	N	1	2	20	1	44
13	76	M	N	N	1	1	20	1	52
14	76	F	N	N	1	1	20	0	13
15	94	F	N	Y	1	2	17	0	32
16	89	F	Y	Y	2	-	4	0	5
17	76	F	N	Y	1	2	17	0	4
18	76	F	N	N	1	2	20	1	7
19	77	F	N	N	1	2	20	1	13
20	82	F	N	N	1	1	20	2	132
21	77	M	N	N	1	1	20	1	18
22	79	F	N	N	1	1	20	0	11
23	77	F	N	N	1	2	19	2	164
24	76	M	N	N	1	1	20	2	115
25	84	M	N	Y	1	2	20	1	18
26	84	F	Y	N	1	1 +	12	0	2
27	80	F	N	N	1	2	20	1	81
28	89	M	N	N	1	1 +	12	1	104
29	76	M	N	Y	2	-	11	1	57
30	91	F	Y	N	2	-	9	0	3
31	81	M	N	N	1	2	20	1	69
32	76	F	Y	N	1	1 +	14	2	178
33	93	F	N	N	1	1	20	0	28
34	84	M	N	N	1	2	20	1	112
35	76	M	N	N	1	1	20	0	92
36	85	F	N	N	1	2	20	2	216
37	77	F	Y	N	1	2	20	2	121
38	76	F	N	N	1	1	20	2	194
39	79	F	Y	Y	1	2 +	9	0	4
40	87	F	N	N	1	2	20	1	72
41	81	M	N	N	1	2	20	1	64
42	81	F	N	Y	1	1 +	14	0	6
43	79	M	N	N	1	1	20	1	33
44	81	F	N	N	1	1	20	1	97
45	84	F	N	N	1	1	20	2	164
46	86	M	N	Y	1	2	18	0	12
47	77	F	N	N	1	1	19	2	159
48	93	F	N	N	1	1	20	1	104
49	77	M	N	N	1	1	20	1	59
50	89	F	N	N	1	1	20	1	91
51	79	F	Y	N	1	1	20	1	88
52	87	F	N	Y	2	-	14	1	116
53	81	F	N	Y	1	2	20	0	88
54	85	F	Y	N	1	1 +	13	1	113
55	76	F	N	N	1	1	20	1	84

Table 2.1. contd/

Table 2.1 (contd). Basic demographic data including patient characteristics, lengths of hospital stay and outcome in 96 elderly (age >75 years) stroke patients included in the study on determinants of stroke outcome in the elderly (Chapters 4 & 5).

Pt No.	Age yrs	Sex	Prev. Str.	Demen.	Prev. Res.	Status	Pre.BADL	Outcome	LOS days
56	87	F	N	N	1	1	20	1	10
57	77	F	Y	N	1	2 +	11	1	108
58	78	M	Y	Y	1	2 +	13	1	13
59	79	M	Y	N	1	1	20	1	92
60	77	F	N	N	1	1	20	1	84
61	84	F	N	Y	1	2	20	2	218
62	86	F	N	N	1	1	20	1	71
63	83	M	N	N	1	1	18	1	69
64	81	M	N	N	1	1	20	1	17
65	76	F	N	N	1	1	19	1	66
66	83	F	N	N	1	1	20	1	73
67	93	F	N	N	1	2	20	1	76
68	81	F	Y	Y	2	-	4	0	14
69	85	M	N	N	1	1	20	1	114
70	78	F	N	N	1	1	18	1	11
71	77	F	Y	Y	1	2 +	12	2	96
72	77	F	N	Y	1	2	18	0	21
73	76	M	N	N	1	1	20	1	108
74	84	F	Y	N	1	1	20	0	1
75	77	F	N	N	1	1	20	1	18
76	78	F	N	N	1	1	20	0	84
77	85	M	N	N	1	1	20	0	108
78	86	M	N	N	1	1 +	13	0	3
79	77	F	Y	Y	1	2 +	8	0	2
80	78	F	N	N	1	1	20	1	97
81	78	M	N	N	1	1	20	0	1
82	76	F	N	N	1	1	20	1	37
83	76	F	N	N	1	1	20	1	9
84	77	M	Y	N	2	-	8	0	5
85	93	F	Y	Y	1	2 +	7	0	4
86	78	F	N	N	1	1	18	1	14
87	79	F	N	N	1	1	20	1	72
88	87	F	N	N	1	1	19	1	71
89	77	F	N	Y	1	1 +	14	0	12
90	76	F	N	N	1	1	20	1	9
91	76	F	N	N	1	1	20	0	54
92	84	F	N	N	1	1	17	0	14
93	77	F	N	Y	1	2	18	0	7
94	77	F	N	Y	1	2	17	1	17
95	97	F	N	N	1	1 +	12	0	11
96	86	F	N	N	1	2	20	1	72

Prev. Str.: Previous strokes;
Demen.: Known premorbid dementia;
Prev. Res,: Previous residence - 1: own home; 2: institutional care;
Status: Family status - 1: living alone; 2: living with spouse/carer;
+ : needs support with personal ADL;
Pre BADL: Premorbid Barthel Activities of Daily Living Index;
Outcome: 0 = death; 1 = discharge home; 2 = long-term care;
LOS: Hospital Length of stay.

Table 2.2. Neurological deficits identified at initial stroke assessment at the time of admission in 86 stroke patients aged over 75 years. All assessments undertaken within 72 hours of admission except that for level of consciousness (GCS) which was undertaken on admission (Chapters 4 & 5).

Pt No.	Side	GCS	MRC Arm	MRC Leg	Aware	Sens Loss	H'opia	Inatt	D'asia	D'agia	Urin Cont	BI	MTS
1	R	6	3	5	Y	N	N	N	N	0	N	6	10
2	R	5	4	4	Y	N	Y	N	Y	0	Y	2	8*
3	L	1	0	5	N	N	Y	Y	N	0	Y	4	10
5	R	6	3	3	Y	N	N	N	N	0	N	2	10
6	R	4	0	2	N	Y	Y	X	Y	1	Y	2	7*
7	L	6	0	0	N	N	Y	Y	N	1	Y	2	9
8	R	6	4	4	Y	N	N	N	N	0	N	8	10
10	R	5	5	4	Y	N	N	Y	Y	0	Y	6	10*
11	R	6	2	3	Y	N	N	N	N	0	N	4	10
12	U	5	4	4	Y	N	N	N	N	0	N	3	10
13	R	5	3	3	Y	Y	N	Y	Y	0	Y	1	10*
14	R	1	0	2	Y	N	Y	Y	N	0	Y	4	10
16	L	1	0	5	N	N	Y	Y	N	1	Y	0	3
17	L	1	0	3	N	N	Y	Y	N	0	Y	3	4
18	R	6	3	4	Y	N	N	N	N	0	N	5	10
19	U	6	3	4	Y	N	N	N	N	0	Y	6	10
20	L	2	0	0	N	Y	Y	X	N	0	Y	0	10
21	R	6	4	4	Y	N	N	N	N	0	N	7	10
22	L	1	2	2	N	N	N	Y	N	1	Y	2	9
23	L	1	2	4	N	N	Y	Y	N	0	Y	4	10
24	L	2	3	3	N	Y	Y	N	N	1	Y	4	10
25	U	6	2	3	Y	N	N	N	N	0	N	7	10
27	R	4	0	5	N	N	Y	N	Y	0	Y	3	10*
28	L	5	4	2	N	N	N	Y	N	0	Y	0	10
29	R	6	3	3	Y	N	N	Y	N	0	Y	1	6
31	U	6	4	2	Y	N	Y	Y	N	0	Y	4	10
32	L	1	0	4	N	Y	Y	X	N	0	Y	2	8
33	R	2	0	0	N	N	Y	Y	Y	0	Y	4	10
34	L	5	3	5	N	N	N	N	N	0	Y	6	3
35	L	6	0	0	N	N	Y	Y	N	1	Y	5	9
36	L	1	0	0	N	Y	Y	X	N	1	Y	0	4
37	L	1	2	2	N	Y	Y	X	N	0	Y	0	2
38	L	2	3	3	N	N	Y	Y	N	0	Y	3	0
39	L	1	0	0	N	N	Y	N	N	1	Y	5	10
40	R	4	4	3	N	N	N	Y	Y	0	Y	0	10*
41	R	6	3	4	Y	N	N	N	N	0	Y	6	9
42	L	2	1	2	Y	N	N	Y	N	1	Y	0	2
43	R	6	4	4	Y	N	N	Y	Y	0	Y	2	6*
44	R	4	3	3	N	N	Y	Y	Y	0	Y	0	-
45	L	1	2	0	N	Y	Y	X	N	0	Y	0	1
46	L	2	2	3	Y	N	Y	Y	N	0	Y	2	0
47	L	2	2	2	N	N	N	N	N	0	N	4	9
48	L	6	3	3	N	N	Y	Y	N	0	Y	4	7
49	U	6	5	2	Y	N	N	N	N	0	Y	2	8
50	R	5	4	3	Y	N	N	Y	N	0	Y	3	4
51	L	5	2	4	N	N	N	Y	N	0	Y	2	8
52	L	2	4	4	N	N	N	N	N	0	Y	5	6
53	R	5	2	2	N	N	Y	Y	Y	1	Y	1	-
54	L	6	1	3	Y	N	N	Y	N	0	Y	1	4
55	R	6	5	3	Y	N	Y	N	N	0	Y	2	8
56	R	6	3	3	Y	N	N	N	N	0	N	6	10
57	R	5	4	4	Y	N	N	Y	Y	0	Y	6	6*
58	R	6	3	4	Y	N	N	N	N	0	N	8	5
59	U	6	5	2	N	N	N	N	N	0	Y	6	9

Table 2.2 contd/

Table 2.2 (contd). Neurological deficits identified at initial stroke assessment at the time of admission in 86 stroke patients aged over 75 years. All assessments undertaken within 72 hours of admission except that for level of consciousness (GCS) which was undertaken on admission (Chapters 4 & 5).

Pt No.	Side	GCS	MRC Arm	MRC Leg	Aware	Sens Loss	H'opia	Inatt	D'asia	D'agia	Urin Cont	BI	MTS
56	R	6	3	3	Y	N	N	N	N	0	N	6	10
57	R	5	4	4	Y	N	N	Y	Y	0	Y	6	6*
58	R	6	3	4	Y	N	N	N	N	0	N	8	5
59	U	6	5	2	N	N	N	N	N	0	Y	6	9
60	L	5	2	4	Y	N	Y	Y	N	0	Y	2	3
61	R	4	2	3	N	Y	N	Y	Y	0	Y	3	-
62	L	6	1	5	Y	N	N	Y	N	0	Y	6	9
63	L	6	5	3	Y	N	N	Y	N	0	Y	1	8
64	R	6	3	4	Y	N	N	N	N	0	N	8	8
65	L	6	3	5	Y	N	N	Y	N	0	Y	5	8
66	L	6	4	4	Y	N	N	N	N	0	Y	5	5
67	R	5	2	5	Y	N	N	Y	Y	0	Y	0	6
68	L	1	3	3	N	N	Y	Y	N	1	Y	4	3
69	L	3	3	2	N	N	N	Y	N	0	Y	1	4
70	R	6	2	3	Y	N	N	N	N	0	N	7	10
71	R	4	0	0	N	Y	Y	X	Y	0	Y	0	-
72	U	1	3	3	Y	N	N	N	N	0	Y	2	4
73	L	4	0	3	N	N	N	Y	N	0	Y	3	8
75	R	6	3	4	Y	N	N	N	N	0	N	5	10
76	L	5	2	2	N	N	Y	Y	N	1	Y	3	9
77	L	5	1	5	N	N	Y	Y	N	1	Y	2	10
80	R	5	3	4	N	N	N	Y	Y	0	Y	5	10*
82	L	6	3	3	Y	N	N	N	N	0	N	4	10
83	R	6	5	4	Y	N	N	N	N	0	Y	8	10
84	L	2	0	3	N	N	N	Y	N	0	Y	0	10
85	L	1	0	2	N	N	N	Y	N	1	Y	4	2
86	R	6	3	4	Y	N	N	N	N	0	N	5	10
87	R	6	1	3	Y	N	Y	Y	Y	0	Y	5	-
88	R	6	3	3	Y	N	N	Y	N	0	Y	4	4
89	L	1	3	3	Y	N	Y	Y	N	0	Y	1	6
90	R	6	2	4	Y	N	N	N	N	0	N	4	10
92	L	1	4	5	Y	N	N	Y	N	1	Y	6	9
93	R	2	2	3	N	Y	Y	X	Y	1	Y	3	-
94	R	6	3	3	Y	N	N	N	N	0	N	3	8
95	L	2	3	3	N	N	N	Y	N	1	Y	4	10
96	L	6	2	4	Y	N	Y	Y	N	0	Y	3	10

Side - Side of stroke; L: Left-sided; R: Right-sided; U: Unsided
GCS - Glasgow Coma Scale (Motor Response)
MRC - Medical Research Council grading for power (0-5)
Aware - Awareness of deficit
Sens Loss - Sensory loss
H'opia - Hemianopia
Inatt - Sensory or visual inattention
D'asia - Dysphasia
D'agia - Dysphagia
Percept - Perceptual deficits on Rivermead Battery; 0: Absent; 1: Present
Urin Cont - Urinary incontinence
BI - Barthel Activities of Daily Living Index
MTS - Mental Test Score; (-): assessment not possible; *: assessed using suggested responses

(In patients with bilateral weakness the power on the weaker side recorded)

(GCS scores are those recorded at the time of admission; other scores recorded when possible but within 72 hours of admission.)

Table 2.3. Prognostic Scores measured at 1, 2 and 4 weeks after stroke, Barthel ADL index measured at 2 weeks after stroke and Barthel ADL index and Functional Ambulation Categories measured at discharge in the 64 elderly (aged over 75 years) stroke survivors (Chapters 4 & 5).

Pt No.	Week 1		Week 2			Week 4		Discharge	
	OPS	EPS	OPS	EPS	BADL*	OPS	EPS	BADL	FAC
1	2.0	2.4	x	x	18	x	x	18	4
2	4.4	3.6	3.2	2.8	5	3.2	2.8	12	4
5	3.6	3.6	2.8	2.8	12	x	x	15	4
6	5.2	4.4	5.2	4.4	4	5.2	4.2	7	2
8	3.2	3.2	x	x	20	x	x	20	4
10	4.4	3.6	3.2	3.2	9	3.2	3.2	16	4
11	3.2	3.2	x	x	14	x	x	14	3
12	3.2	3.2	3.2	3.2	6	3.2	3.2	17	5
13	4.0	4.0	4.0	4.0	4	4.0	4.0	12	1
18	2.0	2.8	x	x	20	x	x	20	4
19	2.4	2.4	2.4	2.4	19	x	x	19	4
20	5.6	5.2	5.2	5.2	0	4.8	4.8	3	0
21	2.0	2.4	2.0	2.0	16	x	x	19	4
23	5.6	4.8	5.2	4.8	4	5.2	4.8	6	1
24	6.4	5.6	5.6	5.6	2	5.6	5.6	2	1
25	3.6	3.6	2.8	2.8	16	x	x	18	5
27	4.0	4.0	4.0	4.0	6	4.0	4.0	12	0
28	4.0	4.0	4.0	4.0	7	4.0	4.0	16	2
29	6.4	4.8	3.6	3.2	9	3.6	3.2	17	4
31	6.4	5.2	4.8	4.8	7	4.0	4.0	11	0
32	6.0	5.2	5.6	5.2	2	5.2	4.8	4	0
34	4.8	3.6	3.6	2.4	9	3.6	2.4	11	5
36	6.4	5.6	6.0	4.8	0	6.0	4.8	0	0
37	5.6	5.6	5.6	4.8	3	5.6	4.8	3	1
38	6.8	4.0	5.2	4.0	2	5.2	4.0	2	0
40	4.4	4.4	4.4	4.4	4	4.4	4.4	13	2
41	3.6	3.2	3.6	3.2	9	3.6	3.2	12	4
43	4.8	3.6	4.4	3.6	9	4.4	3.6	16	4
44	4.8	3.6	4.8	3.6	6	4.8	3.6	12	2
45	6.0	4.0	5.2	4.0	3	5.2	4.0	5	1
47	6.0	4.0	5.6	3.2	7	5.6	3.2	8	2
48	4.0	2.8	3.6	2.8	7	3.6	2.8	12	5
49	3.6	3.2	3.6	3.2	6	3.6	3.2	13	4
50	3.6	2.4	3.6	2.4	7	3.6	2.4	16	4
51	3.6	3.2	3.6	3.2	5	3.6	3.2	13	4
52	3.2	2.8	3.2	2.8	8	3.2	2.8	13	4
54	4.4	3.2	4.4	3.2	7	4.4	3.2	15	2
55	4.4	4.0	3.6	3.2	5	3.6	3.2	12	5
56	2.4	2.4	x	x	16	x	x	16	3

Table 2.3 contd/

Table 2.3 (contd). Prognostic Scores measured at 1, 2 and 4 weeks after stroke, Barthel ADL index measured at 2 weeks after stroke and Barthel ADL index and Functional Ambulation Categories measured at discharge in the 64 elderly (aged over 75 years) stroke survivors (Chapters 4 & 5).

Pt No.	Week 1		Week 2			Week 4		Discharge	
	OPS	EPS	OPS	EPS	BADL*	OPS	EPS	BADL	FAC
57	4.4	3.2	3.6	2.8	8	3.6	2.8	12	4
58	2.8	2.8	x	x	20	x	x	20	5
59	3.2	2.8	3.2	2.8	9	3.2	2.8	13	5
60	3.6	2.4	3.6	2.4	6	3.6	2.4	13	5
61	6.4	3.6	5.6	2.8	4	5.2	2.8	7	2
62	4.8	4.0	4.0	3.6	9	3.2	2.8	17	3
63	3.6	3.2	3.6	3.2	5	3.2	2.8	11	3
64	2.8	2.8	2.4	2.4	15	x	x	18	5
65	3.2	2.4	3.2	2.4	8	2.8	2.0	17	5
66	4.0	2.8	3.2	2.4	8	3.2	2.4	17	4
67	3.6	2.8	3.6	2.8	8	3.6	2.8	17	4
69	5.2	3.2	4.0	2.8	4	4.0	2.8	13	3
70	2.4	2.4	x	x	16	x	x	16	5
71	5.6	5.2	5.6	5.2	3	5.6	5.2	4	0
73	5.2	4.4	4.0	3.6	6	4.0	3.6	12	4
75	3.2	3.2	2.0	2.4	18	x	x	20	5
80	4.4	3.2	4.4	3.2	8	4.4	3.2	8	0
82	3.2	2.8	3.2	2.8	7	3.2	2.8	16	5
83	2.8	2.8	x	x	14	x	x	14	3
86	2.0	2.4	x	x	19	x	x	19	5
87	4.0	2.8	4.0	2.8	8	4.0	2.8	15	4
88	4.0	2.8	4.0	2.8	11	4.0	2.8	17	4
90	2.0	2.4	x	x	19	x	x	19	5
94	2.4	2.4	x	x	15	x	x	15	4
96	5.6	4.8	4.4	4.4	6	4.4	4.4	12	1

OPS: Orpington Prognostic Score

EPS: Edinburgh Prognostic Score

BADL: Barthel Activities Daily Living

FAC: Functional Ambulation Categories

* : BADL at 2 weeks is the same as that at discharge in the 11 stroke patients discharged within 2 weeks.

Table 3.1. Demographic characteristics and neurological impairment following stroke in 217 survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Age yrs	Sex	Prev Str	Dem	Prev Stat	Str side	MRC Arm	MRC Leg	Sens Imp	Hemi anop	Dys sia	Dys gia	Urin Cont
1	88	F	N	N	1	L	0	0	1	1	0	0	1
2	80	M	Y	N	1	R	0	2	1	1	1	0	1
3	76	F	N	N	1	L	3	3	0	0	0	0	0
4	86	F	N	N	1	L	3	4	0	0	0	0	1
5	76	M	N	Y	2 +	L	0	3	0	0	0	0	0
6	81	F	N	Y	2 +	R	1	3	0	0	0	0	1
7	83	M	N	N	1	R	3	0	1	0	1	0	0
8	79	F	N	N	1	L	3	2	0	0	0	0	0
9	78	M	N	Y	2 +	R	3	3	0	0	0	0	1
10	87	F	N	N	1 +	R	5	3	0	1	0	0	1
11	83	F	N	N	1 +	R	2	4	0	0	0	0	0
12	76	F	N	N	1	R	5	3	0	0	0	0	1
13	82	F	Y	N	2	L	0	0	1	1	0	0	1
14	81	F	N	N	1	L	0	2	0	1	0	0	1
15	85	M	N	Y	2 +	R	0	0	1	0	1	0	1
16	77	M	N	N	1	R	3	4	0	0	0	0	0
17	76	F	Y	Y	2 +	L	0	1	0	0	0	1	1
18	83	F	N	N	1	R	0	0	0	0	1	1	1
19	77	F	Y	N	2 +	L	0	4	1	0	0	0	1
20	87	M	N	N	1	R	5	3	0	0	0	0	0
21	81	F	N	N	1	L	3	3	0	0	0	0	0
22	91	M	N	N	2	L	0	4	0	0	0	0	1
23	82	M	N	Y	2 +	L	0	0	1	1	0	1	1
24	79	F	N	N	1	U	2	3	0	0	0	0	1
25	87	M	Y	Y	2 +	L	3	3	0	1	0	0	1
26	91	F	N	N	2	L	3	4	0	0	0	0	1
27	84	F	N	N	2	L	3	3	0	0	0	0	1
28	86	M	N	N	1	L	2	4	0	0	0	0	0
29	83	F	N	N	1 +	R	3	4	0	0	0	0	0
30	89	F	Y	N	2	R	1	3	0	0	1	0	1
31	76	F	N	N	1	L	3	3	0	0	0	0	1
32	81	F	N	N	2	L	0	0	1	1	0	0	1
33	83	F	N	N	1	L	3	4	0	0	0	0	0
34	76	M	N	N	2	R	5	4	0	0	1	0	0
35	76	F	Y	Y	2 +	L	2	0	0	1	0	0	1
36	76	F	Y	N	1	R	4	4	0	0	1	0	1
37	87	M	N	N	2	L	2	3	0	0	0	0	0
38	91	M	N	N	2	L	1	2	0	1	0	0	0
39	77	F	N	N	1	U	3	4	0	0	0	0	0
40	78	F	N	N	2	R	3	4	0	0	0	0	0
41	91	F	N	N	2	L	3	4	0	0	0	0	0
42	76	M	N	N	1	R	4	4	0	0	0	0	0
43	77	F	Y	Y	2 +	L	0	0	0	0	0	1	1
44	83	F	N	N	1	R	3	4	0	0	0	0	0
45	77	F	Y	N	1 +	L	3	3	0	0	0	0	0
46	76	M	N	N	2	L	3	4	0	1	0	0	0
47	77	F	N	N	2	L	3	3	1	1	0	0	1
48	78	F	N	N	1	L	2	4	0	1	0	0	0
49	78	F	N	N	1	U	1	3	0	0	0	0	0
50	79	M	N	N	1	L	4	4	1	0	0	0	0
51	77	F	N	Y	2	R	0	3	0	1	0	0	1
52	83	F	N	Y	2 +	L	2	4	0	1	0	0	1
53	88	F	N	N	1	R	3	5	0	1	0	0	1
54	86	F	Y	Y	2 +	R	0	0	0	1	1	0	1
55	81	F	N	Y	2 +	L	2	2	0	0	0	0	1

Table 3.1 contd/

Table 3.1 (contd). Demographic characteristics and neurological impairment following stroke in 217 survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Age yrs	Sex	Prev Str	Dem	Prev Stat	Str side	MRC Arm	MRC Leg	Sens Imp	Hemi anop	Dys sia	Dys gia	Urin Cont
56	87	M	N	N	1	U	5	2	0	0	0	0	1
57	89	F	N	N	1	R	2	5	0	1	1	0	0
58	77	F	N	Y	2 +	R	3	3	0	0	0	0	0
59	84	F	N	N	1	U	3	4	0	0	0	0	0
60	76	F	N	Y	2 +	R	5	4	0	0	0	0	0
61	76	M	Y	Y	2 +	R	3	4	0	0	0	0	0
62	77	M	N	Y	2 +	U	5	5	0	0	1	0	1
63	77	F	N	N	1	L	3	3	0	0	0	0	0
64	88	F	N	N	1	R	3	4	0	0	1	0	1
65	88	F	N	N	1	R	0	0	0	1	1	0	1
66	81	F	N	N	2	R	3	4	0	0	0	0	0
67	84	F	N	N	2	R	2	3	0	0	0	0	0
68	91	M	N	N	1 +	L	1	3	1	1	0	0	1
69	86	M	Y	N	2	R	3	3	1	1	0	0	1
70	85	M	Y	N	2	U	5	2	0	0	0	0	0
71	76	M	N	Y	2 +	R	3	4	1	1	0	0	1
72	84	F	Y	N	2	R	0	3	0	0	1	0	1
73	77	F	N	N	1	U	3	3	0	0	0	0	0
74	85	M	N	N	1	R	4	4	0	0	1	0	0
75	89	F	Y	Y	2 +	L	0	0	0	1	0	1	1
76	79	F	N	N	1	R	0	2	0	1	1	1	1
77	79	M	Y	N	1 +	L	3	4	0	1	0	0	1
78	81	M	Y	N	2 +	L	3	3	0	0	0	0	1
79	83	F	N	N	2	R	1	3	0	1	1	0	1
80	76	F	N	N	1	R	4	3	1	0	0	0	0
81	81	F	Y	N	1	L	2	4	0	0	0	0	0
82	81	F	N	Y	2 +	L	2	3	0	0	0	0	1
83	77	F	Y	Y	2 +	R	0	0	0	1	1	1	1
84	88	F	N	N	1	L	0	2	0	1	0	0	1
85	77	F	N	N	1	R	2	3	0	0	0	0	1
86	84	F	N	N	1 +	R	0	3	0	1	1	0	0
87	81	M	N	N	1	L	0	1	0	0	0	0	1
88	84	F	N	N	1	L	3	4	0	0	0	0	0
89	77	M	N	N	2	U	4	2	0	1	0	0	1
90	89	M	N	N	1	R	3	4	0	0	0	0	0
91	89	F	N	N	1	R	4	4	0	0	1	0	0
92	84	M	Y	N	2 +	R	4	4	1	1	1	1	1
93	76	M	N	N	1	R	3	4	0	0	0	0	0
94	82	F	Y	N	1	L	2	3	1	1	0	0	1
95	76	F	Y	N	2 +	L	3	3	0	0	0	0	0
96	88	M	N	N	2	R	3	4	0	0	0	0	0
97	85	F	N	N	1	R	4	3	0	1	0	0	0
98	84	F	N	N	1	R	3	3	0	1	1	0	1
99	81	F	N	Y	2 +	L	2	2	0	0	0	0	1
100	76	M	N	N	1	L	2	2	0	0	0	0	0
101	78	F	N	Y	2 +	L	2	3	0	1	0	0	1
102	86	M	N	N	2	U	2	3	0	0	0	0	1
103	76	F	N	N	1	L	1	1	0	0	0	0	1
104	87	F	N	N	1	L	2	2	0	0	0	0	1
105	94	F	Y	Y	2 +	L	0	0	0	0	0	1	1
106	80	F	N	N	2	R	1	3	0	0	1	0	0
107	83	F	N	N	1	L	2	4	1	0	0	0	1
108	82	M	N	N	1	R	4	4	1	0	1	0	0
109	76	F	Y	Y	2 +	R	1	2	0	1	1	0	1
110	76	F	N	N	2	L	2	3	0	0	0	0	1

Table 3.1 contd/

Table 3.1 (contd). Demographic characteristics and neurological impairment following stroke in 217 survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Age yrs	Sex	Prev Str	Dem	Prev Stat	Str side	MRC Arm	MRC Leg	Sens Imp	Hemi anop	Dys sia	Dys gia	Urin Cont
111	81	F	N	N	1	R	3	4	1	1	1	1	1
112	82	M	Y	N	2	R	1	4	1	1	0	0	0
113	76	F	N	N	2	L	0	0	1	1	0	0	1
114	82	F	N	Y	2	L	1	4	0	0	0	0	1
115	78	F	N	N	2	R	4	4	0	1	1	0	0
116	82	F	N	N	1	R	0	3	0	1	1	0	1
117	91	M	N	N	1	R	2	2	0	0	0	0	1
118	82	F	Y	N	2 +	R	0	4	1	0	1	0	1
119	83	M	N	N	2	L	3	3	0	0	0	0	0
120	76	M	N	N	1	L	3	4	1	0	0	0	0
121	76	F	N	N	2	L	2	4	1	0	0	0	1
122	86	M	N	N	1	L	3	3	1	1	0	0	1
123	85	F	N	N	1	L	4	4	0	1	0	0	1
124	81	F	Y	N	2	R	3	4	0	0	0	0	0
125	77	M	Y	Y	2 +	L	0	0	0	1	0	1	1
126	89	M	N	N	1	L	2	0	0	0	0	0	1
127	87	F	N	N	1	L	4	4	1	1	0	0	1
128	92	F	N	N	2	R	3	3	0	0	0	0	0
129	86	M	N	N	1	L	5	3	0	0	0	0	0
130	82	M	N	Y	2 +	L	0	3	1	1	0	1	1
131	79	F	N	N	2	L	4	4	0	0	0	0	0
132	76	F	N	N	1	L	4	4	0	0	0	0	1
133	86	M	N	N	2	L	3	4	0	0	0	0	1
134	87	M	N	N	1	L	3	5	0	0	0	0	0
135	76	F	Y	N	1	R	0	0	0	0	1	1	1
136	83	F	N	N	2	R	2	3	0	0	0	0	1
137	87	F	N	N	1	R	3	3	0	0	0	0	0
138	82	M	N	N	1	L	2	2	0	0	0	0	0
139	89	F	N	Y	2 +	R	2	3	1	0	1	0	1
140	76	F	N	N	1	L	0	4	0	1	0	0	1
141	93	F	N	N	2	L	3	4	0	0	0	0	0
142	84	M	N	Y	2 +	U	2	3	0	0	0	0	1
143	89	M	N	N	1	R	1	3	0	0	0	0	1
144	77	M	N	N	1	L	5	0	0	0	0	0	0
145	84	F	N	Y	2 +	L	2	0	1	1	0	0	1
146	77	F	Y	N	1 +	R	2	4	0	0	1	0	1
147	86	M	N	Y	2 +	R	0	2	0	0	0	1	1
148	77	F	Y	N	2	L	1	2	0	0	0	0	1
149	91	F	N	N	1	R	2	3	0	0	0	0	1
150	82	M	Y	N	2 +	L	0	0	0	0	0	1	1
151	76	M	N	N	1	L	3	4	0	0	0	0	0
152	89	F	N	N	1	L	3	4	0	0	0	0	0
153	79	F	N	N	1	R	4	3	1	0	0	0	0
154	91	F	N	N	1	R	2	2	0	0	0	0	0
155	80	M	N	N	1	L	3	2	0	0	0	0	1
156	83	F	N	N	2	L	0	0	1	1	0	1	1
157	82	F	Y	N	1 +	L	1	3	0	0	0	0	1
158	87	F	Y	Y	2 +	L	2	2	0	1	0	0	1
159	84	F	N	N	1	R	3	3	0	0	1	0	0
160	81	F	N	N	2	L	2	2	0	1	0	0	1
161	81	F	N	N	1	R	1	3	0	0	0	0	0
162	76	F	N	N	1	R	3	3	0	0	0	0	1
163	77	F	N	N	1	L	3	3	1	0	0	0	0
164	80	F	N	N	1 +	L	4	3	0	0	0	0	0
165	93	F	N	N	2	L	4	4	0	0	0	0	0
166	84	F	N	N	2	R	3	3	0	1	0	0	1
167	87	M	N	N	1	L	3	4	0	0	0	0	1
168	79	F	N	N	1	L	1	3	0	0	0	0	0

Table 3.1 contd/

Table 3.1 (contd). Demographic characteristics and neurological impairment following stroke in 217 survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Age yrs	Sex	Prev Str	Dem	Prev Stat	Str side	MRC Arm	MRC Leg	Sens Imp	Hemi anop	Dys sia	Dys gia	Urin Cont
169	85	M	Y	N	2	R	3	2	0	0	0	0	0
170	87	M	N	N	2	L	1	1	1	1	0	0	1
171	89	F	N	N	1	R	3	3	0	0	0	0	1
172	79	M	N	N	1	L	2	2	0	0	0	0	1
173	77	M	N	N	1	L	2	3	0	1	0	0	0
174	78	F	Y	N	2 +	L	3	2	0	0	0	0	1
175	81	F	N	N	1	R	4	3	0	0	0	0	0
176	93	F	N	N	1	L	3	4	0	0	0	0	0
177	89	F	N	N	1	R	3	3	0	1	1	0	1
178	89	F	Y	N	2	L	0	4	0	1	0	0	1
179	76	F	N	N	1	R	0	3	0	0	1	0	0
180	76	F	N	N	2	L	2	3	0	0	0	0	0
181	77	F	N	N	1	L	3	3	0	0	0	0	0
182	82	F	N	Y	2 +	L	3	4	0	0	0	0	0
183	84	F	N	N	1	R	2	2	1	1	1	1	1
184	85	F	N	N	1	R	3	3	0	0	0	0	1
185	93	M	N	N	1	L	4	2	0	0	0	0	0
186	76	F	N	N	2	R	2	3	0	1	0	0	0
187	89	F	N	N	1	R	0	2	1	0	0	0	0
188	76	F	N	N	2	R	3	3	0	0	0	0	0
189	87	M	N	N	1	L	3	4	0	0	0	0	0
190	77	F	N	N	1	R	3	4	0	0	0	0	0
191	81	F	N	N	1	R	0	3	0	0	0	0	1
192	91	F	N	N	2	R	4	4	0	0	0	0	0
193	82	F	N	N	1	L	0	3	0	0	0	0	1
194	85	M	N	N	1	R	1	3	0	1	0	0	0
195	91	F	N	N	1	R	1	3	1	1	0	1	1
196	85	M	N	N	2	L	4	2	0	0	0	0	1
197	79	F	N	N	1	R	3	3	0	0	0	0	0
198	79	F	N	N	1	R	4	3	0	0	0	0	0
199	79	F	N	N	2	R	0	3	0	0	0	0	0
200	87	F	N	N	1	R	3	3	0	1	1	0	1
201	86	M	N	Y	2	L	0	3	1	1	0	1	1
202	86	F	N	N	1	L	5	3	0	0	0	0	0
203	83	F	N	Y	1 +	L	1	3	0	0	0	0	1
204	88	M	Y	Y	2 +	L	0	2	0	1	0	0	0
205	87	F	Y	N	1	R	1	0	0	0	1	1	1
206	83	F	N	N	1	R	0	3	0	1	0	0	1
207	79	F	N	N	2	L	2	2	1	1	0	0	1
208	77	F	Y	N	2 +	R	0	3	0	0	1	0	1
209	84	F	N	N	1	R	4	4	1	0	1	0	0
210	77	F	N	N	2	L	4	3	0	0	0	0	0
211	79	F	N	N	2	R	2	3	0	0	0	0	0
212	76	M	N	N	2	L	1	4	1	1	0	0	1
213	83	F	N	N	2	L	0	3	1	0	0	0	0
214	76	F	N	N	1	L	3	3	0	1	0	0	0
215	86	F	Y	N	1 +	L	0	0	1	0	0	0	1
216	85	F	N	N	2	R	2	3	0	0	0	0	0
217	84	F	N	N	2	L	0	3	0	0	0	0	1

Prev Str: previous strokes; Dem: known dementia; Prev Stat: previous status (i.e. living alone - 1; with spousse/carer - 2; + if help needed with personal ADL); Str side: side of stroke; MRC: Medical Research Council grading for power; Sens Imp: sensory impairment (0 - absent; 1 - present); Hemi anop: Hemianopia (0 - absent; 1 - present); Dys sia: Dysphasia (0 - absent; 1 - present); Dys gia: Dysphagia (0 - absent; 1 - present); Urin Cont: Urinary Incontinence (0 - absent; 1 - present).

(In patients with bilateral weakness the power on the weaker side recorded)

Table 3.2. Orpington Prognostic scores and urinary incontinence measures at 1, 2 and 4 weeks after stroke, dependency levels at discharge, destination of discharge and Barthel ADL index at admission and on discharge in 217 stroke survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Orpington Prognostic Score			Urinary Incontinence			Dep.	Dest	BADL	
	Week 1	Week 2	Week 4	Week 1	Week 2	Week 4	Level	Dx.	Ad.	Dx.
1	6.0	5.2	5.2	1	1	1	3	3	3	6
2	5.6	4.8	3.6	1	1	0	2	3	2	11
3	2.8	2.8	x	0	0	x	1	1	4	17
4	2.8	2.8	2.4	1	0	0	1	1	3	16
5	4.4	4.0	3.6	0	0	0	2	1	3	11
6	4.4	4.4	3.6	1	1	1	2	3	4	11
7	5.2	4.0	3.6	0	0	0	2	1	1	11
8	4.4	4.0	2.8	0	0	0	2	1	3	15
9	4.8	3.6	3.2	0	0	0	2	1	1	11
10	4.8	3.6	3.6	0	0	0	2	2	2	13
11	2.8	2.0	x	0	0	x	1	1	4	19
12	4.0	2.8	2.4	1	0	0	1	1	4	17
13	6.0	6.0	5.6	1	1	1	3	3	2	4
14	6.0	6.0	5.6	1	1	1	3	3	5	9
15	6.0	6.0	5.2	1	1	1	3	3	2	8
16	2.4	2.0	2.0	0	0	0	1	1	6	18
17	6.0	6.0	5.6	1	1	1	3	3	2	8
18	6.0	6.0	6.0	1	1	1	3	2	1	10
19	5.6	4.8	3.6	1	0	0	2	1	2	15
20	2.4	2.4	2.0	0	0	0	1	1	5	17
21	2.8	2.8	x	0	0	x	1	1	4	18
22	5.2	3.2	2.4	1	1	0	2	2	0	12
23	6.8	6.0	6.0	1	1	1	3	3	4	8
24	4.0	4.0	3.2	1	1	0	2	1	6	16
25	5.6	4.4	3.6	1	1	1	2	3	0	12
26	2.8	2.8	2.8	1	0	0	1	1	6	19
27	4.8	3.2	2.8	1	1	0	2	1	3	16
28	2.8	2.4	x	0	0	x	1	1	3	18
29	2.4	2.0	x	0	0	x	1	1	5	20
30	5.6	4.8	4.0	1	1	0	2	3	4	12
31	4.4	4.0	2.8	1	1	1	2	3	2	12
32	6.4	6.0	6.0	1	1	0	3	1	4	10
33	2.4	2.4	x	0	0	x	1	1	4	17
34	4.4	3.2	2.8	0	0	0	2	1	2	14
35	6.0	6.0	5.6	1	1	1	3	3	0	6
36	5.6	3.6	2.8	0	0	0	2	1	3	12
37	6.0	3.6	3.2	0	0	0	2	1	2	12
38	5.6	4.8	4.4	0	0	0	2	3	0	12
39	2.4	2.0	x	0	0	x	1	1	7	20
40	3.6	2.8	x	0	0	x	1	1	4	18
41	5.6	3.2	2.8	0	0	0	2	1	5	16
42	2.8	2.0	x	0	0	x	1	1	5	19
43	6.0	6.0	6.0	1	1	1	3	3	0	5
44	2.8	2.4	x	0	0	x	1	1	5	17
45	3.6	2.8	x	0	0	x	1	1	2	17
46	4.4	3.2	3.6	0	0	0	2	2	3	16
47	5.6	4.0	3.6	1	1	0	2	3	2	11
48	4.8	3.6	3.6	0	0	0	2	2	2	12
49	4.4	4.0	3.6	0	0	0	2	1	2	12
50	2.8	2.4	x	0	0	x	1	1	3	17
51	5.6	4.0	3.2	1	0	0	2	3	1	12
52	5.6	4.8	4.0	1	1	0	2	3	0	12
53	4.8	4.0	4.0	1	1	1	2	3	5	16
54	6.0	5.6	6.4	1	1	1	3	3	0	8
55	4.4	3.6	2.4	1	1	1	2	3	4	12

Table 3.2. contd/

Table 3.2 (contd). Orpington Prognostic scores and urinary incontinence measures at 1, 2 and 4 weeks after stroke, dependency levels at discharge, destination of discharge and Barthel ADL index at admission and on discharge in 217 stroke survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Orpington Prognostic Score			Urinary Incontinence			Dep.	Dest	BADL	
	Week 1	Week 2	Week 4	Week 1	Week 2	Week 4	Level	Dx.	Ad.	Dx.
56	5.2	4.0	3.6	0	0	0	2	1	2	14
57	4.4	4.0	3.6	0	0	0	2	1	0	16
58	2.4	2.4	2.4	0	0	0	1	1	3	16
59	2.4	2.4	x	0	0	x	1	1	4	16
60	3.6	2.8	x	0	0	x	1	1	5	18
61	3.6	2.8	x	0	0	x	1	1	5	17
62	5.6	4.0	3.2	1	1	0	2	3	0	11
63	3.6	2.8	x	0	0	x	1	1	4	19
64	4.4	4.4	3.2	1	0	0	2	1	5	15
65	6.4	6.0	5.6	1	1	1	3	3	2	6
66	2.8	2.0	x	0	0	x	1	1	5	17
67	2.4	2.4	x	0	0	x	1	1	4	16
68	4.4	4.4	3.6	1	1	1	2	3	4	11
69	4.4	3.6	2.8	0	0	0	2	2	0	15
70	4.0	3.2	2.4	0	0	0	2	1	4	13
71	6.4	3.6	2.8	0	0	0	2	1	4	16
72	5.0	4.8	3.6	1	1	0	2	1	3	13
73	2.4	2.4	x	0	0	x	1	1	4	18
74	5.6	4.4	3.6	0	0	0	2	1	0	16
75	6.8	6.8	5.6	1	1	1	3	3	2	7
76	5.6	5.2	5.2	1	1	1	3	3	2	9
77	6.0	4.0	4.0	1	0	0	2	1	3	15
78	3.6	3.2	2.4	1	0	0	1	1	4	18
79	4.4	4.0	4.0	1	0	0	2	1	3	11
80	5.6	3.2	2.8	0	0	0	2	1	5	15
81	4.4	3.6	3.6	0	0	0	2	1	0	15
82	6.4	4.4	3.6	1	0	0	2	3	3	13
83	6.4	6.4	6.0	1	1	1	3	3	2	8
84	6.4	5.6	5.2	1	0	0	3	1	6	10
85	4.8	4.0	4.8	1	1	1	2	3	3	12
86	4.8	4.0	3.6	0	0	0	2	1	3	12
87	6.0	5.2	5.2	1	1	1	3	1	0	6
88	2.4	2.0	x	0	0	x	1	1	5	18
89	6.0	4.8	4.0	1	1	0	2	3	0	12
90	2.8	2.4	2.0	0	0	0	1	1	6	17
91	5.2	3.2	3.2	0	0	0	2	1	2	18
92	6.0	6.0	5.6	1	0	0	3	3	4	10
93	2.4	2.4	x	0	0	x	1	1	4	18
94	6.0	4.8	4.0	1	1	1	2	3	4	12
95	3.6	3.2	x	0	0	x	1	1	2	19
96	4.8	3.6	3.6	0	0	0	2	1	3	16
97	5.6	3.6	3.2	0	0	0	2	2	4	18
98	5.2	4.8	3.6	1	0	0	2	3	0	14
99	6.0	4.8	3.6	1	1	1	2	3	4	11
100	4.4	3.2	2.4	0	0	0	2	2	5	18
101	5.6	4.4	3.6	1	1	1	2	3	2	13
102	5.2	4.0	4.4	1	1	0	2	3	2	12
103	4.8	4.4	2.8	1	1	1	2	3	2	11
104	4.8	3.2	2.8	1	1	0	1	1	3	17
105	6.4	6.4	5.6	1	1	1	3	3	0	5
106	4.8	4.0	3.6	0	0	0	2	1	0	14
107	5.6	5.2	5.6	1	1	0	3	1	6	10
108	2.4	2.4	x	0	0	x	1	1	4	16
109	6.0	5.2	4.8	1	0	0	3	3	2	6
110	4.4	4.4	3.6	1	1	1	2	3	2	11

Table 3.2. contd/

Table 3.2 (contd). Orpington Prognostic scores and urinary incontinence measures at 1, 2 and 4 weeks after stroke, dependency levels at discharge, destination of discharge and Barthel ADL index at admission and on discharge in 217 stroke survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Orpington Prognostic Score			Urinary Incontinence			Dep.	Dest	BADL	
	Week 1	Week 2	Week 4	Week 1	Week 2	Week 4	Level	Dx.	Ad.	Dx.
111	6.8	6.0	6.0	1	1	1	3	3	2	8
112	5.6	4.0	3.2	0	0	0	2	2	4	13
113	6.0	5.6	4.8	1	0	0	3	3	0	9
114	6.4	4.0	4.0	1	1	1	2	3	4	12
115	5.6	3.2	2.8	0	0	0	2	2	2	11
116	6.0	5.6	5.6	1	1	0	3	3	2	7
117	4.4	3.6	2.8	1	1	1	2	3	0	13
118	4.8	4.8	4.4	1	0	0	2	1	0	16
119	3.6	2.8	x	0	0	x	1	1	4	18
120	3.6	2.8	x	0	0	x	1	1	6	18
121	5.2	3.6	3.2	1	1	1	2	3	1	12
122	5.2	3.6	3.2	1	1	1	2	3	0	11
123	2.4	2.4	2.0	1	1	0	1	1	4	18
124	3.6	2.8	x	0	0	x	1	1	5	19
125	6.8	6.8	6.4	1	1	1	3	3	2	6
126	6.0	5.6	5.6	1	1	1	3	1	4	10
127	5.6	4.4	4.0	1	0	0	2	1	3	14
128	4.0	3.2	3.2	0	0	0	2	1	0	17
129	4.4	4.0	3.6	0	0	0	2	2	1	11
130	6.4	6.4	5.6	1	1	1	3	3	5	8
131	2.4	2.0	x	0	0	x	1	1	4	18
132	4.4	3.2	3.2	1	1	0	2	1	1	12
133	4.0	3.6	3.6	1	1	1	2	3	2	11
134	4.0	3.6	3.6	0	0	0	2	1	4	12
135	6.8	6.4	5.6	1	1	1	3	3	1	6
136	4.0	2.8	x	1	0	x	1	1	6	16
137	4.0	3.2	3.2	0	0	0	2	1	2	16
138	5.6	3.2	2.8	0	0	0	2	1	4	16
139	5.6	4.0	3.6	1	1	1	2	3	3	11
140	5.2	4.0	4.0	1	1	0	2	3	3	12
141	3.6	2.8	2.0	0	0	0	1	1	2	16
142	3.6	2.8	2.4	1	0	0	1	1	3	18
143	5.6	4.8	4.4	1	0	0	2	3	2	18
144	4.0	3.2	3.2	0	0	0	2	1	2	16
145	6.4	5.2	5.2	1	1	1	3	3	0	10
146	4.4	4.4	3.6	1	1	0	2	1	5	14
147	5.6	4.8	4.0	1	1	0	2	3	6	17
148	4.8	4.4	2.4	1	0	0	2	1	3	16
149	4.8	4.4	4.0	1	1	1	2	3	2	12
150	6.8	6.8	6.0	1	1	1	3	3	3	6
151	4.8	3.6	2.4	0	0	0	2	1	3	18
152	4.0	3.2	3.2	0	0	0	2	1	2	15
153	4.8	3.2	2.8	0	0	0	2	1	5	18
154	4.4	3.2	2.4	0	0	0	2	1	3	18
155	4.0	4.0	3.6	1	0	0	2	1	0	11
156	5.6	6.0	5.6	1	1	1	3	3	0	5
157	5.2	4.4	3.6	1	0	0	2	1	1	14
158	4.8	4.4	3.6	1	1	0	2	3	6	15
159	5.6	3.6	3.6	0	0	0	2	1	2	16
160	4.0	4.0	3.6	1	1	0	2	1	0	16
161	4.8	4.0	3.6	0	0	0	2	1	4	16
162	4.4	4.0	3.6	1	1	0	2	1	2	12
163	6.4	4.8	4.0	0	0	0	2	1	4	14
164	5.2	3.6	3.2	0	0	0	2	1	2	11
165	2.8	2.0	x	0	0	x	1	1	4	16

Table 3.2. contd/

Table 3.2 (contd). Orpington Prognostic scores and urinary incontinence measures at 1, 2 and 4 weeks after stroke, dependency levels at discharge, destination of discharge and Barthel ADL index at admission and on discharge in 217 stroke survivors over 75 years of age included in the validation study (Chapter 6).

Pt No.	Orpington Prognostic Score			Urinary Incontinence			Dep.	Dest	BADL	
	Week 1	Week 2	Week 4	Week 1	Week 2	Week 4	Level	Dx.	Ad.	Dx.
166	5.0	4.0	3.6	1	0	0	2	1	4	15
167	3.6	2.4	2.4	1	0	0	1	1	2	16
168	4.8	4.0	3.6	0	0	0	2	1	0	13
169	5.6	3.2	2.4	0	0	0	2	1	3	15
170	6.4	4.8	3.6	1	1	1	2	3	4	12
171	3.6	2.4	2.4	1	1	0	1	1	6	16
172	2.8	2.8	2.8	1	0	0	1	1	3	17
173	2.8	2.8	x	0	0	x	1	1	3	17
174	4.0	4.0	3.6	1	0	0	2	1	2	14
175	4.0	3.6	3.6	0	0	0	2	1	3	17
176	2.8	2.4	x	0	0	x	1	1	2	17
177	5.6	4.8	3.6	1	0	0	2	1	4	13
178	6.0	4.8	3.6	1	1	0	2	3	2	13
179	4.4	4.0	3.6	0	0	0	2	1	0	16
180	4.4	4.0	3.2	0	0	0	2	1	2	17
181	5.6	4.0	3.6	0	0	0	2	1	4	14
182	5.6	3.2	3.2	0	0	0	2	1	5	13
183	5.6	4.8	4.0	1	1	0	2	3	2	12
184	4.8	4.0	3.6	1	0	0	2	1	4	11
185	5.2	3.2	2.4	0	0	0	2	1	3	13
186	5.6	4.0	3.6	0	0	0	2	2	1	14
187	4.0	4.0	3.6	0	0	0	2	1	5	17
188	3.6	2.8	x	0	0	x	1	1	2	17
189	2.8	2.8	x	0	0	x	1	1	5	17
190	3.6	2.8	x	0	0	x	1	1	4	17
191	5.6	4.0	2.8	1	0	0	2	1	3	12
192	2.4	2.0	x	0	0	x	1	1	7	20
193	5.6	4.4	3.2	1	1	0	2	3	0	13
194	4.8	4.4	4.0	0	0	0	2	1	5	17
195	5.6	4.8	3.6	1	0	0	2	1	3	14
196	4.4	4.0	3.6	1	0	0	2	1	0	13
197	6.0	3.2	2.8	0	0	0	2	1	0	11
198	5.6	3.6	3.6	0	0	0	2	1	2	15
199	4.4	4.0	3.6	0	0	0	2	1	0	11
200	5.2	4.4	3.2	1	1	1	2	3	2	11
201	6.0	5.2	6.0	1	1	1	3	3	2	10
202	2.4	2.0	x	0	0	x	1	1	2	16
203	6.0	4.8	3.6	1	1	1	2	3	2	15
204	5.2	3.6	3.6	0	0	0	2	3	0	11
205	6.0	6.0	6.0	1	1	1	3	3	2	6
206	5.6	4.8	3.6	1	1	0	2	3	4	14
207	5.2	4.8	4.4	1	1	0	2	3	1	11
208	6.4	4.8	3.6	1	0	0	2	3	3	13
209	2.8	2.4	x	0	0	x	1	1	3	17
210	2.4	2.0	x	0	0	x	1	1	2	16
211	2.4	2.0	x	0	0	x	1	1	4	18
212	4.8	4.4	3.6	1	1	1	2	3	2	13
213	6.0	4.8	4.4	0	0	0	2	1	5	16
214	6.0	3.6	3.6	0	0	0	2	2	4	16
215	5.6	5.6	5.6	1	1	1	3	3	2	6
216	4.8	3.6	2.4	0	0	0	2	1	0	14
217	5.2	4.4	2.8	1	1	1	2	3	0	11

Urinary Incontinence: 0 - continent; 1 - incontinent.
Dep. Level: Dependency level at discharge (see Chapter 6 for details) -
1: Independent ; 2: Limited dependence; 3: Fully dependent.
Dest. Dx: Destination of discharge -
1: Previous residence; 2: assisted schemes; 3: institutional care.
BADL: Barthel ADL index - Ad.: on admission; Dx: At discharge.

Table 4.1a Patient characteristics, prognostic scores, lengths of hospital stay and destination and Barthel index at discharge of 73 elderly (age >75 years) stroke patients managed on general wards (Chapters 7,8 & 9).

Pt No.	Age yrs	Sex	Old St	Dementia	OPS	LOS days	Ds Dx	BADL	Setting
101	82	F	N	N	4.0	74	1	14	GMW
102	83	M	N	N	3.6	146	2	6	GMW
103	77	F	N	Y	2.8	11	1	20	GMW
104	76	F	N	N	4.0	75	2	7	GMW
105	79	F	Y	N	5.6	89	0	-	GMW
106	84	M	N	N	3.2	87	1	16	GMW
107	81	M	N	N	2.4	21	1	18	GMW
108	87	F	N	N	4.4	83	1	14	GMW
109	89	M	N	N	5.2	114	2	11	GMW
110	79	F	Y	N	4.8	141	1	13	GMW
111	91	F	N	N	2.0	29	2	14	GMW
112	84	F	Y	N	4.4	83	1	17	GMW
113	76	M	N	N	2.4	18	1	20	GMW
114	79	M	N	N	3.6	137	1	14	GMW
115	93	F	Y	N	5.2	113	2	6	GMW
116	82	F	N	N	4.4	81	2	8	GMW
117	83	F	N	N	4.8	182	1	16	GMW
118	88	F	N	N	2.8	15	1	17	GMW
119	94	F	N	Y	6.0	34	0	-	GMW
120	81	M	N	N	4.0	83	2	10	GMW
121	86	F	N	N	2.0	16	1	16	GMW
122	77	M	N	N	3.2	79	1	16	GMW
123	76	F	N	N	5.6	89	0	-	GMW
124	86	F	N	N	3.6	143	1	11	GMW
125	93	F	N	N	4.4	84	2	5	GMW
126	82	F	Y	Y	6.4	94	0	-	GMW
127	83	F	N	N	3.2	82	1	17	GMW
128	87	F	N	N	4.8	142	2	9	GMW
129	88	M	N	N	2.8	19	1	17	GMW
130	76	M	N	Y	6.0	106	2	8	GMW
131	79	F	N	N	4.4	139	0	-	GMW
132	81	F	Y	N	4.8	83	2	12	GMW
133	91	F	N	N	4.8	136	1	14	GMW
134	87	F	N	N	2.4	17	1	17	GMW
135	84	M	N	N	3.6	78	2	6	GMW
136	81	M	N	N	5.2	215	0	-	GMW
137	79	F	N	N	3.2	142	1	15	GMW
138	76	M	N	N	3.2	81	1	12	GMW
139	77	F	N	N	2.0	15	1	20	GMW
140	85	F	Y	N	4.4	134	1	17	GMW
141	84	F	N	Y	6.4	189	0	-	GMW
142	87	F	Y	N	4.0	145	1	14	GMW
143	82	M	N	N	3.6	82	2	13	GMW
144	83	F	N	N	2.4	15	1	18	GMW
145	82	F	N	N	4.4	142	0	-	GMW
146	91	F	N	N	4.8	131	2	13	GMW
147	77	F	N	N	4.0	79	1	12	GMW
148	76	F	N	N	2.8	13	1	19	GMW
149	78	M	Y	Y	6.0	207	0	-	GMW
150	81	F	N	N	4.4	129	2	6	GMW
151	88	F	N	N	4.0	144	1	14	GMW
152	76	F	N	N	2.4	18	1	17	GMW
153	79	M	Y	N	3.6	81	1	15	GMW
154	85	F	N	N	4.4	136	2	8	GMW

Table 4.1a contd/

Table 4.1a (contd). Patient characteristics, prognostic scores, lengths of hospital stay and destination and Barthel index at discharge of 73 elderly (age >75 years) stroke patients managed on general wards (Chapters 7,8 & 9).

Pt No.	Age yrs	Sex	Old St	Dementia	OPS	LOS days	Ds Dx	BADL	Setting
155	89	F	N	N	2.0	17	1	16	GMW
156	87	F	N	N	4.8	88	1	13	GMW
157	83	M	N	Y	5.6	110	0	-	GMW
158	86	F	N	N	4.0	79	1	16	GMW
159	85	F	N	N	3.2	88	1	12	GMW
160	76	M	N	N	2.4	10	1	18	GMW
161	89	F	Y	Y	6.4	69	0	-	GMW
162	86	F	N	N	4.8	196	1	14	GMW
163	77	F	N	N	4.0	77	2	16	GMW
164	79	M	Y	N	4.0	147	1	15	GMW
165	80	F	N	N	4.0	84	2	12	GMW
166	82	F	N	N	5.2	109	2	7	GMW
167	87	F	N	N	3.6	89	1	17	GMW
168	91	F	N	N	4.8	81	2	4	GMW
169	83	M	N	Y	6.0	158	0	-	GMW
170	86	F	N	N	4.0	142	1	15	GMW
171	84	F	N	N	4.0	76	2	7	GMW
172	83	M	N	Y	6.0	144	2	8	GMW
173	89	F	N	N	3.6	105	1	10	GMW

Old St: Previous Strokes
OPS: Orpington Prognostic Score
LOS: Length of stay after randomisation
Ds Dx: Discharge destination
0 = death; 1 = discharge home; 2 = long-term care
GMW: General ward
BADL: Barthel Activities of Daily Living index

Table 4.1b. Patient characteristics, prognostic scores, lengths of hospital stay and destination of discharge of 71 elderly (age >75 years) stroke patients managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

Pt No.	Age yrs	Sex	Old Str	Dementia	OPS	LOS days	Ds Dx	BADL	Setting
201	76	F	N	N	5.6	64	1	8	SU
202	77	M	N	N	4.8	35	2	9	SU
203	83	F	Y	N	2.8	6	1	19	SU
204	84	F	Y	Y	6.8	22	0	-	SU
205	86	M	N	N	2.4	4	1	20	SU
206	82	F	N	N	5.6	62	2	8	SU
207	81	F	N	N	2.0	8	1	18	SU
208	76	F	Y	N	4.8	64	2	12	SU
209	77	M	N	N	2.4	12	1	17	SU
210	79	F	N	N	2.4	14	1	18	SU
211	80	F	N	N	5.2	61	1	12	SU
212	81	M	Y	N	5.6	49	2	10	SU
213	84	F	N	N	2.8	22	1	14	SU
214	82	M	N	N	2.4	37	1	16	SU
215	81	F	N	Y	4.4	35	2	13	SU
216	85	F	N	N	3.6	46	1	16	SU
217	86	M	Y	N	3.2	31	1	15	SU
218	77	F	N	N	2.8	12	1	18	SU
219	79	M	N	N	4.4	34	1	12	SU
220	78	F	N	N	5.6	54	2	6	SU
221	89	F	N	N	4.4	71	2	6	SU
222	84	M	N	Y	4.8	36	1	17	SU
223	83	F	N	N	4.4	34	1	14	SU
224	85	F	N	N	3.2	33	1	20	SU
225	77	M	N	N	3.6	35	1	12	SU
226	79	F	Y	N	4.8	77	0	-	SU
227	82	F	N	N	5.2	66	1	11	SU
228	84	M	N	N	4.8	46	1	18	SU
229	86	F	N	N	4.0	69	1	12	SU
230	83	M	N	N	2.8	8	1	20	SU
231	91	F	N	N	2.4	11	1	17	SU
232	76	F	N	N	5.6	69	2	9	SU
233	78	M	N	Y	3.6	66	2	8	SU
234	88	F	N	N	4.0	35	1	17	SU
235	83	F	N	N	2.0	12	1	20	SU
236	91	M	N	N	4.4	81	1	13	SU
237	82	F	Y	Y	5.2	68	2	6	SU
238	84	F	N	N	5.6	25	0	-	SU
239	81	M	N	N	3.2	34	1	18	SU
240	77	F	N	N	4.0	69	2	12	SU
241	89	F	N	Y	4.8	35	2	15	SU
242	82	M	Y	N	4.0	66	1	9	SU
243	89	F	N	N	3.2	81	1	11	SU
244	77	F	N	N	3.2	34	1	16	SU
245	76	F	Y	N	4.8	72	1	15	SU
246	76	M	Y	N	4.8	73	2	10	SU
247	87	F	N	N	4.0	59	1	17	SU
248	84	F	Y	N	4.4	35	1	20	SU
249	86	M	N	N	4.8	56	1	12	SU
250	89	F	N	N	4.4	36	2	7	SU
251	91	F	Y	N	5.6	67	2	4	SU
252	84	M	N	N	3.2	35	1	18	SU
253	85	F	N	N	3.2	77	0	-	SU

Table 4.1b contd/

Table 4.1b (contd). Patient characteristics, prognostic scores, lengths of hospital stay and destination of discharge of 71 elderly (age >75 years) stroke patients managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

Pt No.	Age yrs	Sex	Old Str	Dementia	OPS	LOS days	Ds Dx	BADL	Setting
254	83	F	Y	Y	6.4	66	0	-	SU
255	81	F	N	N	3.6	34	1	19	SU
256	83	F	N	N	3.6	62	2	12	SU
257	89	M	N	N	4.4	33	1	17	SU
258	82	F	N	Y	4.0	67	2	8	SU
259	77	F	N	N	3.6	32	1	16	SU
260	76	F	N	N	4.2	43	1	16	SU
261	89	F	N	N	4.0	74	1	13	SU
262	85	F	N	N	3.2	31	1	15	SU
263	89	F	N	N	4.8	77	1	10	SU
264	87	F	Y	N	4.8	73	2	13	SU
265	84	F	N	N	3.2	32	1	18	SU
266	85	M	N	N	3.6	69	1	19	SU
267	76	F	N	N	4.4	69	1	15	SU
268	76	F	N	Y	4.4	34	2	10	SU
269	79	M	N	N	5.6	74	0	-	SU
270	92	F	N	N	4.8	71	1	16	SU
271	81	F	N	N	3.2	34	1	18	SU

Old St: Previous Strokes
OPS: Orpington Prognostic Score
LOS: Length of stay after randomisation
Ds Dx: Discharge destination
0 = death; 1 = discharge home; 2 = long-term care
GMW: General ward
BADL: Barthel Activities of Daily Living index

Table 4.1c. Patient characteristics, prognostic scores, lengths of hospital stay and destination of discharge of 48 young (aged 75 or less) stroke patients managed on general wards (Chapters 7,8 & 9).

Pt No.	Age yrs	Sex	Old St	Dementia	OPS	LOS days	Ds Dx	BADL	Setting
301	69	F	N	N	3.6	57	1	13	GMW
302	64	M	N	N	2.4	12	1	19	GMW
303	75	F	N	N	4.4	141	2	8	GMW
304	72	M	N	N	2.0	14	1	18	GMW
305	75	F	N	N	4.4	139	1	16	GMW
306	72	M	N	N	2.8	14	1	17	GMW
307	75	F	Y	Y	5.6	84	2	4	GMW
308	75	M	N	N	3.2	49	1	12	GMW
309	74	M	N	N	4.8	214	2	9	GMW
310	72	M	N	N	4.2	56	2	13	GMW
311	71	F	N	N	4.0	131	1	15	GMW
312	74	M	N	N	2.4	18	1	17	GMW
313	66	M	N	N	4.4	58	2	10	GMW
314	74	F	N	N	2.0	13	1	19	GMW
315	41	M	N	N	4.8	137	1	14	GMW
316	75	M	N	N	3.6	56	2	13	GMW
317	74	M	N	N	2.8	12	1	19	GMW
318	72	F	N	N	2.4	16	1	17	GMW
319	75	M	N	N	4.0	51	1	18	GMW
320	74	M	N	N	2.4	8	1	20	GMW
321	73	F	Y	N	4.4	139	2	12	GMW
322	51	F	N	N	4.8	127	0	-	GMW
323	75	M	N	N	4.4	58	2	11	GMW
324	73	F	N	N	2.8	21	1	18	GMW
325	72	M	N	N	4.4	144	1	13	GMW
326	74	M	N	N	4.0	57	2	8	GMW
327	73	F	N	N	2.4	11	1	18	GMW
328	72	M	N	N	3.6	133	1	13	GMW
329	74	M	N	Y	4.4	55	2	11	GMW
330	69	F	N	N	3.2	126	1	12	GMW
331	75	F	N	N	2.8	12	1	20	GMW
332	63	M	N	N	4.4	59	2	10	GMW
333	73	M	N	N	2.8	14	1	18	GMW
334	72	M	N	N	3.2	131	1	13	GMW
335	71	M	Y	N	6.0	132	0	-	GMW
336	74	F	N	N	2.4	16	1	17	GMW
337	74	F	N	N	4.8	129	2	10	GMW
338	74	F	N	N	2.8	15	1	19	GMW
339	73	M	N	N	2.8	13	1	20	GMW
340	75	M	N	N	3.6	56	2	11	GMW
341	75	M	N	N	2.4	16	1	20	GMW
342	67	F	N	N	3.2	57	1	18	GMW
343	74	M	N	N	4.0	136	2	8	GMW
344	75	M	N	N	2.0	7	1	20	GMW
345	74	M	N	N	6.4	161	0	-	GMW
346	73	M	N	N	4.4	56	2	10	GMW
347	75	F	N	N	2.0	14	1	18	GMW
348	74	F	N	N	4.8	59	2	12	GMW

Old St: Previous Strokes
OPS: Orpington Prognostic Score
LOS: Length of stay after randomisation
Ds Dx: Discharge destination
0 = death; 1 = discharge home; 2 = long-term care
GMW: General ward
BADL: Barthel Activities of Daily Living index

Table 4.1d. Patient characteristics, prognostic scores, lengths of hospital stay and destination of discharge of 53 young (aged 75 or less) stroke patients managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

Pt No.	Age yrs	Sex	Old St	Dementia	OPS	LOS days	Ds Dx	BADL	Setting
401	75	M	N	N	3.2	26	1	17	SU
402	72	M	N	N	4.0	24	1	19	SU
403	72	F	N	N	4.4	58	1	14	SU
404	74	F	N	N	6.4	21	0	-	SU
405	73	M	N	N	2.0	17	1	17	SU
406	75	M	N	N	2.8	11	1	16	SU
407	72	M	N	N	2.4	10	1	18	SU
408	75	F	N	N	4.4	36	1	18	SU
409	74	F	N	N	5.6	56	2	8	SU
410	73	M	N	N	2.0	14	1	20	SU
411	75	F	N	Y	3.6	35	1	16	SU
412	70	M	N	N	4.8	32	1	18	SU
413	67	M	N	N	2.8	6	1	20	SU
414	72	M	N	N	4.4	34	2	11	SU
415	68	M	N	N	2.4	8	1	19	SU
416	54	M	N	N	4.8	78	1	15	SU
417	75	M	Y	N	6.0	24	0	-	SU
418	69	M	N	N	4.4	48	1	16	SU
419	61	F	N	N	4.0	31	1	20	SU
420	68	M	N	N	2.0	6	1	20	SU
421	67	F	N	N	3.6	35	1	17	SU
422	64	F	N	N	4.4	22	1	17	SU
423	71	F	Y	N	6.0	72	2	7	SU
424	74	M	N	N	4.8	69	2	16	SU
425	75	M	N	N	4.8	64	1	11	SU
426	74	M	N	N	4.0	28	1	19	SU
427	73	F	N	N	3.6	26	1	18	SU
428	72	M	N	N	2.8	10	1	20	SU
429	73	F	N	N	2.4	12	1	19	SU
430	71	F	N	N	3.2	57	1	14	SU
431	72	F	N	N	4.8	26	0	-	SU
432	66	M	N	N	3.2	35	1	18	SU
433	74	M	N	N	5.6	64	2	4	SU
434	75	F	N	N	4.4	61	1	13	SU
435	73	M	N	N	2.8	16	1	18	SU
436	72	M	N	N	3.6	36	1	19	SU
437	65	M	N	N	2.8	13	1	19	SU
438	74	F	N	N	3.6	24	1	18	SU
439	74	M	N	N	2.4	12	1	18	SU
440	72	M	N	N	4.4	62	1	16	SU
441	74	F	N	N	2.4	11	1	17	SU
442	72	F	N	N	2.8	12	1	19	SU
443	74	M	N	N	4.8	62	1	12	SU
444	72	M	N	N	4.4	59	2	9	SU
445	74	F	Y	N	2.0	16	1	19	SU
446	69	M	N	N	3.2	56	1	12	SU
447	65	M	N	N	2.8	18	1	16	SU
448	75	F	N	N	4.8	34	1	18	SU
449	71	M	N	N	2.4	11	1	18	SU
450	75	M	N	N	2.4	14	1	20	SU
451	71	M	N	N	4.0	66	1	11	SU
452	72	M	N	N	2.8	16	1	17	SU
453	74	M	N	N	2.0	29	1	20	SU

Old St: Previous Strokes
OPS: Orpington Prognostic Score
LOS: Length of stay after randomisation
Ds Dx: Discharge destination
0 = death; 1 = discharge home; 2 = long-term care
GMW: General ward
BADL: Barthel Activities of Daily Living index

Table 4.2a. Neurological deficits at the time of inclusion into the study in the 73 elderly stroke patients (aged >75 years) managed on general wards (Chapters 7,8 & 9).

Pt No.	Side	MRC Arm	MRC Leg	H'anopia	D'phasia	D'phagia	Percept	Ur Cont	BADL
101	R	1	3	0	1	0	0	1	4
102	L	3	3	1	0	0	1	0	2
103	R	5	4	0	0	0	0	0	8
104	L	3	3	0	0	0	0	0	2
105	R	0	3	1	1	0	0	1	0
106	L	0	4	0	0	0	0	1	5
107	R	3	4	0	0	0	0	0	4
108	U	4	4	0	0	0	0	0	4
109	L	0	3	1	0	1	1	1	2
110	R	0	5	0	1	0	0	1	3
111	U	4	3	0	0	0	0	0	6
112	R	2	4	0	1	0	0	0	5
113	R	5	3	0	0	0	0	0	10
114	R	3	4	1	0	0	1	0	6
115	L	0	3	0	0	0	1	1	2
116	L	2	3	0	0	0	0	0	2
117	R	0	4	0	1	0	1	1	6
118	R	3	4	0	0	0	0	0	4
119	L	0	2	1	0	0	1	1	0
120	U	2	3	0	0	0	0	0	2
121	L	4	4	0	0	0	0	0	4
122	L	3	4	1	0	0	0	0	5
123	R	0	0	0	1	1	1	0	1
124	L	4	3	0	0	0	0	0	2
125	U	0	3	0	0	0	0	1	0
126	L	2	4	1	0	0	1	1	2
127	R	3	3	0	0	0	0	0	6
128	R	2	2	1	1	1	1	1	2
129	L	3	4	0	0	0	0	0	5
130	R	0	3	0	0	0	1	1	2
131	L	3	3	0	0	0	0	1	0
132	L	2	3	1	0	0	1	1	6
133	R	0	3	1	0	0	0	0	4
134	U	3	4	0	0	0	0	0	2
135	L	3	4	0	0	0	0	0	2
136	L	0	3	1	0	0	0	1	1
137	R	4	3	0	0	0	1	0	5
138	L	0	4	0	0	0	0	0	2
139	U	3	4	0	0	0	0	0	12
140	L	2	2	1	0	0	0	1	6
141	R	3	2	1	1	1	1	1	2
142	L	3	2	0	0	0	0	0	6
143	R	2	2	0	0	0	0	0	1
144	L	4	4	1	0	0	0	0	8
145	L	2	3	0	0	0	1	0	2
146	R	0	3	0	1	1	0	1	3
147	U	1	3	0	0	0	0	0	2
148	L	3	4	0	0	0	0	0	6
149	R	0	2	1	1	0	0	1	1
150	L	1	1	0	0	0	0	1	2
151	R	2	3	1	0	0	0	0	4
152	L	3	4	0	0	0	0	0	6
153	R	3	3	1	0	0	1	0	5
154	R	2	3	0	0	0	0	0	2
155	U	5	3	0	0	0	0	0	2
156	R	3	5	1	1	0	0	1	4
157	L	0	3	1	0	0	0	1	0
158	R	1	3	0	0	0	0	0	4
159	R	4	3	0	0	0	1	0	5

Table 4.2a contd/

Table 4.2a (contd). Neurological deficits at the time of inclusion into the study in the 73 elderly stroke patients (aged >75 years) managed on general wards (Chapters 7,8 & 9).

Pt No.	Side	MRC Arm	MRC Leg	H'anopia	D'phasia	D'phagia	Percept	Ur Cont	BADL
160	L	4	4	0	0	0	0	0	6
161	R	0	2	1	1	1	0	1	4
162	L	3	4	0	0	0	1	1	4
163	R	3	5	1	0	0	0	0	5
164	L	3	4	1	0	0	0	1	3
165	R	2	3	0	0	0	0	0	6
166	R	0	3	1	0	0	0	1	2
167	R	4	3	0	0	0	0	0	5
168	L	2	4	1	0	0	1	0	1
169	L	2	4	0	0	0	0	1	4
170	R	3	3	1	0	0	0	0	4
171	L	0	4	1	0	0	0	0	3
172	L	0	3	1	0	0	1	0	5
173	R	4	4	0	0	0	0	0	2

Side - Side of stroke; L: Left-sided; R: Right-sided; U: Unsided
MRC - Medical Research Council grading for power (0-5)
H'anopia - Hemianopia; 0: Absent; 1: Present
D'phasia - Dysphasia; 0: Absent; 1: Present
D'phagia - Dysphagia; 0: Absent; 1: Present
Percept - Perceptual deficits on Rivermead Battery; 0: Absent; 1: Present
Ur Cont - Urinary continence; 0: Absent; 1: Present
BADL - Barthel Activities of Daily Living index

(In patients with bilateral weakness the power on the weaker side recorded)

Table 4.2b. Neurological deficits at the time of inclusion into the study in the 71 elderly stroke patients (aged >75 years) managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

Pt No.	Side	MRC Arm	MRC Leg	H'anopia	D'phasia	D'phagia	Percept	Ur Cont	BADL
201	L	0	3	1	0	0	1	1	4
202	L	1	3	0	0	0	0	0	2
203	R	3	4	0	0	0	0	0	8
204	U	0	0	0	0	1	0	1	0
205	U	3	4	0	0	0	0	0	8
206	R	3	4	1	1	1	1	1	2
207	L	3	4	0	0	0	0	0	10
208	R	1	3	0	1	0	0	0	4
209	L	4	4	0	0	0	1	0	8
210	U	3	3	0	0	0	0	1	5
211	L	0	0	1	0	0	0	0	6
212	R	4	4	1	1	0	1	1	4
213	L	3	4	0	0	0	0	0	6
214	R	4	3	0	1	0	1	0	4
215	L	2	3	1	0	0	0	0	2
216	R	3	3	0	1	0	0	1	5
217	U	3	2	0	0	1	0	0	4
218	R	3	4	0	0	0	0	0	4
219	L	1	5	1	0	0	1	0	4
220	R	3	4	1	1	0	0	1	2
221	L	0	3	0	0	0	0	0	0
222	U	0	2	0	0	1	0	1	6
223	L	4	4	1	0	0	1	0	3
224	R	2	2	0	0	0	0	0	8
225	L	2	3	0	0	0	0	0	6
226	R	1	3	1	1	0	1	0	2
227	L	2	4	0	0	0	1	1	6
228	R	1	1	0	0	0	0	0	6
229	R	3	3	0	0	0	0	0	4
230	L	3	4	0	0	0	1	1	6
231	R	4	4	0	1	0	1	0	6
232	L	0	2	1	0	0	0	1	5
233	U	5	5	0	1	0	0	1	0
234	R	0	2	0	0	0	1	1	5
235	L	4	4	0	0	0	0	0	7
236	L	1	4	1	0	0	1	1	2
237	R	1	2	1	1	0	0	0	2
238	L	2	4	1	0	1	0	1	4
239	L	2	2	0	0	0	0	0	5
240	L	3	3	1	0	0	1	1	2
241	L	1	3	0	0	0	0	0	6
242	R	1	4	1	0	0	1	1	4
243	R	3	4	0	0	0	0	0	3
244	L	3	4	0	0	0	0	1	5
245	L	0	4	0	0	1	1	0	6
246	R	0	4	1	1	0	1	1	4
247	L	2	3	0	0	0	0	0	6
248	L	1	2	0	0	0	0	1	8
249	L	1	1	1	0	0	1	1	4
250	R	3	5	1	1	0	0	0	2
251	U	1	2	0	0	1	0	1	2
252	L	2	2	0	0	0	0	0	6
253	R	3	2	0	0	0	1	0	0
254	U	0	1	0	0	0	0	1	0

Table 4.2b contd/

Table 4.2b (contd). Neurological deficits at the time of inclusion into the study in the 71 elderly stroke patients (aged >75 years) managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

Pt No.	Side	MRC Arm	MRC Leg	H'anopia	D'phasia	D'phagia	Percept	Ur Cont	BADL
255	R	4	3	1	0	0	0	0	7
256	L	2	4	0	0	0	1	0	4
257	R	1	3	1	0	0	0	1	5
258	L	1	4	0	0	0	0	0	4
259	R	2	5	1	1	0	0	0	5
260	U	2	3	0	0	0	0	1	6
261	R	0	3	0	0	0	0	0	4
262	L	3	4	0	0	0	0	1	7
263	R	1	5	1	0	1	1	0	3
264	L	0	4	1	0	0	0	1	2
265	R	3	3	0	0	0	0	0	6
266	L	3	4	0	0	0	0	0	8
267	L	3	3	0	0	0	0	0	3
268	R	1	4	0	0	0	0	1	4
269	R	1	0	1	1	0	0	1	2
270	L	0	3	0	0	0	1	0	5
271	R	4	4	0	1	0	0	0	5

Side - Side of stroke; L: Left-sided; R: Right-sided; U: Unsided
MRC - Medical Research Council grading for power (0-5)
H'anopia - Hemianopia; 0: Absent; 1: Present
D'phasia - Dysphasia; 0: Absent; 1: Present
D'phagia - Dysphagia; 0: Absent; 1: Present
Percept - Perceptual deficits on Rivermead Battery; 0: Absent; 1: Present
Ur Cont - Urinary continence; 0: Absent; 1: Present
BADL - Barthel Activities of Daily Living

(In patients with bilateral weakness the power on the weaker side recorded)

Table 4.2c. Neurological deficits at the time of inclusion into the study in the 48 young stroke patients (aged 75 years or less) managed on general wards (Chapters 7,8 & 9).

Pt No.	Side	MRC Arm	MRC Leg	H'anopia	D'phasia	D'phagia	Percept	Ur Cont	BADL
301	L	3	3	1	0	0	0	0	6
302	R	4	5	0	1	0	1	0	7
303	L	2	3	0	0	0	0	1	0
304	U	5	5	0	0	1	0	0	11
305	L	2	3	1	0	0	1	0	7
306	R	3	4	0	0	0	0	0	9
307	R	2	0	0	1	0	1	1	0
308	L	2	3	0	0	0	0	0	5
309	R	2	3	1	1	0	1	1	0
310	L	2	4	0	0	0	0	0	4
311	R	3	5	0	0	0	1	0	7
312	L	4	4	0	0	0	0	0	5
313	R	3	4	1	1	0	1	1	2
314	L	3	5	0	0	0	0	0	6
315	L	1	2	0	0	0	1	1	0
316	R	1	3	1	1	0	1	0	6
317	L	3	3	0	0	0	0	0	8
318	L	4	4	0	0	0	1	0	7
319	R	2	3	1	0	0	0	0	4
320	R	5	3	0	1	0	0	0	12
321	L	3	0	0	0	0	1	0	6
322	U	1	0	0	0	1	0	1	2
323	L	0	3	0	0	0	0	0	3
324	R	3	4	0	0	0	0	0	7
325	L	4	4	1	0	0	1	0	5
326	R	3	3	0	1	0	0	1	0
327	L	5	2	0	0	0	0	0	10
328	R	4	3	0	0	0	1	1	0
329	R	2	2	0	0	0	0	0	5
330	L	3	3	1	0	0	1	1	0
331	L	3	4	0	0	0	1	0	6
332	L	4	2	0	0	0	0	0	7
333	L	4	4	1	0	0	0	0	8
334	R	3	2	0	1	0	0	0	4
335	U	0	0	0	0	1	0	1	0
336	R	4	4	1	1	0	0	0	3
337	L	0	1	0	0	0	1	1	2
338	L	3	3	0	0	0	0	0	6
339	R	4	4	1	0	0	0	0	5
340	L	4	4	1	0	0	0	0	8
341	R	2	3	0	1	0	1	0	5
342	L	3	3	0	0	0	0	0	5
343	L	3	3	1	0	0	0	1	0
344	U	2	3	0	0	0	0	0	12
345	L	0	0	0	0	0	0	1	0
346	R	3	3	0	1	0	0	0	6
347	L	5	3	0	0	0	0	0	5
348	L	0	2	1	0	0	1	0	4

Side - Side of stroke; L: Left-sided; R: Right-sided; U: Unsided
MRC - Medical Research Council grading for power (0-5)
H'anopia - Hemianopia; 0: Absent; 1: Present
D'phasia - Dysphasia; 0: Absent; 1: Present
D'phagia - Dysphagia; 0: Absent; 1: Present
Percept - Perceptual deficits on Rivermead Battery; 0: Absent; 1: Present
Ur Cont - Urinary continence; 0: continent; 1: incontinent
BADL - Barthel Activities of Daily Living

(In patients with bilateral weakness the power on the weaker side recorded)

Table 4.2d. Neurological deficits at the time of inclusion into the study in the 53 young stroke patients (aged 75 years or less) managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

Pt No.	Side	MRC Arm	MRC Leg	H'anopia	D'phasia	D'phagia	Percept	Ur Cont	BADL
401	L	3	4	0	0	0	0	0	9
402	R	1	0	0	1	0	0	0	7
403	R	3	2	0	1	0	0	1	2
404	L	0	4	1	0	1	0	1	0
405	L	5	5	0	0	0	1	0	5
406	L	2	3	0	0	0	0	0	9
407	R	4	5	0	1	0	0	0	4
408	R	4	4	0	0	0	0	1	10
409	L	1	4	1	0	0	1	0	4
410	R	3	4	1	0	0	0	0	6
411	L	3	3	0	0	0	0	1	3
412	R	4	5	1	1	0	1	0	9
413	R	2	3	0	0	0	0	0	10
414	L	0	0	0	0	0	0	0	0
415	L	4	5	0	0	0	1	0	10
416	R	1	4	0	1	0	1	1	2
417	U	3	3	0	0	1	0	1	0
418	L	2	4	1	0	0	0	0	3
419	R	2	4	0	0	0	0	1	4
420	L	3	3	1	0	0	0	0	8
421	L	5	4	0	0	0	1	0	3
422	R	0	3	1	0	0	0	0	9
423	R	0	3	0	1	1	1	1	0
424	L	2	3	1	0	0	1	1	3
425	R	1	4	0	1	0	0	0	4
426	L	1	0	1	0	0	1	0	10
427	R	1	1	0	1	0	0	0	4
428	L	4	0	1	0	0	1	0	7
429	R	3	4	0	0	0	0	0	6
430	R	2	3	1	0	0	0	0	7
431	L	3	1	1	0	0	1	1	0
432	L	3	4	1	0	0	0	0	5
433	R	0	0	0	1	0	1	1	0
434	R	2	4	1	0	0	0	0	4
435	L	5	5	0	0	0	1	0	5
436	L	1	1	1	0	0	0	0	10
437	L	3	3	0	0	0	0	0	9
438	L	4	5	0	0	0	1	0	10
439	R	0	0	0	0	0	0	0	9
440	L	0	3	1	0	0	0	0	3
441	R	5	5	0	0	0	1	0	10
442	R	2	0	0	0	0	0	0	5
443	L	3	4	1	0	0	0	0	5
444	R	4	5	0	1	0	1	0	3
445	L	0	0	0	0	0	0	0	6
446	R	2	1	0	0	0	0	0	5
447	R	4	4	0	0	0	0	0	6
448	L	4	4	0	0	0	1	1	0
449	R	3	5	0	1	0	0	0	7
450	L	3	4	0	0	0	0	0	5
451	R	4	5	1	0	0	1	1	4
452	L	3	5	0	0	0	0	0	8
453	R	0	0	0	0	0	0	0	4

Side - Side of stroke; L: Left-sided; R: Right-sided; U: Unsided
MRC - Medical Research Council grading for power (0-5)
H'anopia - Hemianopia; 0: Absent; 1: Present
D'phasia - Dysphasia; 0: Absent; 1: Present
D'phagia - Dysphagia; 0: Absent; 1: Present
Percept - Perceptual deficits on Rivermead Battery; 0: Absent; 1: Present
Ur Cont - Urinary continence; 0: continent; 1: incontinent
BADL - Barthel Activities of Daily Living

(In patients with bilateral weakness the power on the weaker side recorded)

Table 4.3a Duration and type of physiotherapy and occupational therapy input in 73 older stroke patients (aged >75 years) managed on general wards (Chapters 7,8 & 9).

	Physiotherapy						Occupational Therapy					
Pt No.	Total hrs	Si Bal sess	St Bal sess	Trans sess	Ambul sess	Ind Reh sess	Total hrs	PADL sess	Kit sess	HV sess	PDFU sess	Ind Reh sess
101	23.5	7	10	3	8	19	13.0	14	3	3	2	4
102	36.0	11	13	29	11	8	11.5	16	2	3	0	2
103	7.0	3	3	2	2	4	6.0	4	2	4	0	2
104	21.0	6	8	15	4	9	9.0	14	2	0	0	2
105	17.0	5	7	13	5	4	14.0	26	0	0	0	2
106	19.0	6	8	10	6	8	14.0	15	3	4	2	4
107	12.0	4	5	5	4	6	13.0	17	3	4	0	2
108	44.5	14	17	17	15	26	16.0	19	4	3	3	3
109	18.0	6	8	8	6	8	13.0	17	2	5	0	2
110	25.0	8	11	12	8	11	11.0	9	3	3	4	3
111	14.0	4	6	8	4	6	13.0	18	2	3	0	3
112	18.0	6	8	9	5	8	7.0	1	4	5	3	1
113	9.0	3	4	4	3	4	8.0	14	1	0	0	1
114	14.0	4	6	8	4	6	14.5	15	2	5	2	5
115	18.5	6	9	12	6	4	13.0	22	2	0	0	2
116	13.5	4	6	7	4	6	11.0	15	2	3	0	2
117	43.0	14	18	14	16	24	13.0	13	3	4	2	4
118	8.0	2	3	3	4	4	7.0	10	2	0	1	1
119	11.0	3	4	8	2	5	12.0	22	0	0	0	2
120	15.0	5	5	8	5	7	9.0	8	4	4	0	2
121	7.0	2	3	3	2	4	6.0	2	4	3	2	1
122	14.0	4	6	7	5	6	15.0	16	3	4	2	5
123	13.0	4	5	9	2	6	8.0	15	1	0	0	0
124	31.5	11	10	16	11	15	14.0	12	4	4	2	6
125	17.0	5	7	9	5	8	12.0	15	3	4	0	2
126	11.0	3	4	7	3	5	7.0	8	0	5	0	1
127	19.0	6	8	10	6	8	9.0	8	3	4	2	1
128	25.5	8	11	11	9	12	15.0	24	3	0	0	3
129	9.0	3	3	5	3	4	8.0	8	1	4	1	2
130	12.0	4	5	5	4	6	13.5	18	2	4	0	3
131	8.0	2	3	4	3	4	6.0	7	1	3	0	1
132	17.0	5	7	9	5	8	11.0	13	2	5	0	2
133	21.0	6	9	12	6	9	14.0	15	3	4	3	3
134	18.0	5	8	10	5	8	7.0	6	3	4	0	1
135	17.0	5	7	9	5	8	11.0	15	2	3	0	2
136	28.5	10	6	16	10	15	13.0	19	3	4	0	0
137	23.0	7	10	11	7	11	13.5	16	1	4	3	3
138	16.0	5	7	8	5	7	8.0	5	4	3	2	2
139	7.0	2	3	2	4	3	6.0	10	1	0	0	1
140	21.0	8	8	11	6	9	12.0	12	4	4	0	4
141	12.0	4	5	6	4	5	5.0	10	0	0	0	0
142	32.0	10	13	17	10	14	13.0	13	3	5	2	3
143	16.0	5	7	8	5	7	9.0	11	2	3	0	2
144	7.0	2	3	3	2	4	5.0	4	2	3	0	1
145	6.0	0	3	4	2	3	14.0	25	3	0	0	0
146	15.0	5	6	7	5	7	11.0	15	2	3	0	2
147	23.0	7	10	12	7	10	8.5	7	2	4	2	2
148	8.0	2	3	4	3	4	7.0	12	1	0	0	1
149	12.0	4	5	6	4	5	10.5	21	0	0	0	0
150	17.0	5	7	10	5	7	6.0	5	2	4	0	1
151	27.0	9	11	13	9	12	11.5	14	2	5	0	2
152	10.0	3	4	6	3	4	5.0	5	0	3	1	1
153	24.0	8	10	11	8	11	11.0	11	3	4	2	2
154	31.0	10	13	15	10	14	13.5	17	3	4	0	3

Table 4.3a contd/

Table 4.3a (contd.) Duration and type of physiotherapy and occupational therapy input in 73 older stroke patients (aged >75 years) managed on general wards (Chapters 7,8 & 9).

	Physiotherapy						Occupational Therapy					
Pt No.	Total hrs	Si Bal sess	St Bal sess	Trans sess	Ambul sess	Ind Reh sess	Total hrs	PADL sess	Kit sess	HV sess	PDFU sess	Ind Reh sess
155	5.0	1	2	1	3	3	6.0	6	2	3	0	1
156	21.0	6	9	10	7	10	9.0	7	2	4	3	2
157	9.0	3	3	5	3	4	3.0	6	0	0	0	0
158	12.0	4	5	6	4	5	11.0	12	2	5	1	2
159	15.0	5	6	7	5	7	8.0	8	3	3	0	2
160	4.0	0	2	1	3	2	5.5	6	0	0	2	3
161	19.0	6	8	10	6	8	13.0	24	0	0	0	2
162	42.0	13	18	22	13	18	11.0	11	2	5	2	2
163	17.0	5	7	10	5	7	13.0	16	3	4	0	3
164	36.0	11	17	17	12	16	11.0	12	3	4	2	2
165	13.0	4	5	7	4	6	9.0	10	2	4	0	2
166	16.0	5	7	8	5	7	11.0	14	2	4	0	2
167	37.0	12	18	16	12	16	8.0	7	2	4	1	2
168	12.0	4	5	6	4	5	11.0	20	0	0	0	2
169	15.0	5	6	7	5	7	8.0	11	1	4	0	0
170	33.0	10	18	12	11	15	12.0	12	3	5	2	2
171	13.0	4	5	7	4	6	11.0	14	2	4	0	2
172	25.0	8	11	12	8	11	10.0	18	0	0	0	2
173	24.0	7	12	10	8	11	12.5	13	3	4	2	3

sess: No. of half-hour sessions of face to face contact work with patients.

Si Bal: Sitting balance; St Bal: Standing balance; Amb: Ambulation; Trans: Transfers; Ind Reh: Individual rehabilitation.
PADL:Personal activities of daily living; Kit: Kitchen activities; HV: Home visits; PDFU: Post discharge follow-up; Ind Reh: Individual rehabilitation.

Table 4.3b Duration and type of physiotherapy and occupational therapy input in 71 older stroke patients (aged >75 years) managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

	Physiotherapy						Occupational Therapy					
Pt No.	Total hrs	Si Bal sess	St Bal sess	Trans sess	Ambul sess	Ind Reh sess	Total hrs	PADL sess	Kit sess	HV sess	PDFU sess	Ind Reh sess
201	21.0	6	9	7	7	12	13.0	13	3	4	3	3
202	18.0	6	8	9	6	7	9.0	14	2	0	0	2
203	3.0	0	0	0	4	2	12.5	14	2	4	2	3
204	9.0	6	0	0	0	12	8.0	16	0	0	0	0
205	2.0	0	0	0	3	1	6.0	5	1	4	1	1
206	21.0	6	8	14	6	8	11.0	15	2	3	0	2
207	3.0	0	2	0	4	0	8.0	8	2	3	1	2
208	16.0	5	7	9	5	6	9.0	11	1	4	0	2
209	13.0	4	6	3	7	6	14.0	15	4	4	2	3
210	6.0	2	3	1	4	2	8.0	6	2	3	1	4
211	28.0	9	14	0	9	24	14.0	13	4	5	3	3
212	24.0	7	16	10	8	7	6.0	6	0	4	0	2
213	12.0	4	8	6	4	2	9.0	10	2	3	2	1
214	16.0	5	7	9	5	6	12.0	13	3	4	2	2
215	19.0	6	8	11	6	7	11.0	15	2	3	0	2
216	22.0	7	9	8	7	13	10.0	8	4	3	3	2
217	18.0	6	8	9	6	7	14.0	16	3	4	2	3
218	7.0	2	3	4	2	3	11.0	14	2	3	1	2
219	21.0	6	9	9	7	11	14.0	13	3	6	3	3
220	23.0	7	10	11	7	11	9.0	11	1	4	0	2
221	19.0	6	8	11	6	7	14.0	20	1	4	0	3
222	17.0	5	7	10	5	7	8.0	4	4	3	3	2
223	13.0	4	6	6	4	6	12.0	14	3	3	2	2
224	14.0	4	6	10	4	4	8.0	7	2	4	1	2
225	17.0	5	7	11	5	6	9.0	8	3	3	2	2
226	8.0	4	2	8	0	2	4.0	4	0	4	0	0
227	21.0	6	9	10	7	10	9.0	9	2	3	1	3
228	24.0	7	11	13	8	9	6.0	6	1	3	1	1
229	19.0	6	8	9	6	9	12.0	14	2	4	2	2
230	5.0	2	2	2	1	3	14.0	16	3	4	2	3
231	4.0	1	2	2	1	2	8.0	9	1	2	2	2
232	11.0	3	5	7	3	4	11.0	19	1	0	0	2
233	21.0	4	8	14	8	8	12.0	17	1	4	0	2
234	15.0	5	6	6	5	8	11.0	10	3	3	2	4
235	6.0	2	3	2	2	3	13.0	14	2	4	3	3
236	12.0	4	5	5	4	6	13.0	15	2	4	2	3
237	31.0	10	14	13	10	15	9.0	15	0	3	0	0
238	12.0	4	5	3	4	8	6.5	13	0	0	0	0
239	11.0	3	5	5	3	6	12.0	14	2	3	1	4
240	17.0	5	7	9	5	8	13.0	17	2	4	0	3
241	14.0	4	6	8	4	6	11.0	20	0	0	0	2
242	22.0	7	10	11	7	9	14.0	17	3	3	2	3
243	17.0	5	8	9	5	7	10.0	11	3	3	1	2
244	11.0	3	5	6	3	5	8.0	7	2	4	1	2
245	34.0	10	15	16	11	16	13.0	15	4	3	2	2
246	8.0	2	3	5	2	4	14.0	20	1	4	0	3
247	31.0	10	13	17	10	12	11.0	11	3	4	2	2
248	14.0	4	6	9	4	5	11.0	13	2	3	2	2
249	12.0	4	5	0	8	7	12.0	13	2	4	3	2
250	15.0	5	6	8	5	6	9.0	11	2	3	0	2
251	21.0	6	9	12	7	8	13.0	20	3	0	0	3
252	13.0	4	6	7	4	5	11.0	10	3	5	2	2
253	21.0	6	9	13	7	7	9.0	18	0	0	0	0
254	11.0	3	5	8	3	3	7.0	14	0	0	0	0

Table 4.3b contd/

Table 4.3b (contd) Duration and type of physiotherapy and occupational therapy input in 71 older stroke patients (aged >75 years) managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

	Physiotherapy						Occupational Therapy					
Pt No.	Total hrs	Si Bal sess	St Bal sess	Trans sess	Ambul sess	Ind Reh sess	Total hrs	PADL sess	Kit sess	HV sess	PDFU sess	Ind Reh sess
255	12.0	4	5	3	4	8	11.0	14	2	3	1	2
256	15.0	5	7	6	5	7	12.0	15	2	4	0	3
257	9.0	3	4	5	3	3	9.0	9	3	3	1	2
258	16.0	5	7	11	5	4	13.0	19	0	4	0	3
259	8.0	2	4	2	2	6	10.0	12	2	3	1	2
260	21.0	6	9	9	9	9	12.0	14	2	4	2	2
261	16.0	5	7	8	5	7	12.0	16	1	4	1	2
262	12.0	4	6	5	4	5	13.0	14	3	4	2	3
263	15.0	5	7	5	5	8	12.0	13	2	4	2	3
264	18.0	6	8	10	6	6	11.0	15	2	3	0	2
265	12.0	4	5	6	4	5	13.0	13	4	4	2	3
266	14.0	4	6	10	5	3	9.0	8	2	3	3	2
267	21.0	6	13	6	7	10	12.0	15	2	3	2	2
268	18.0	6	8	8	6	8	12.0	17	0	4	0	3
269	6.0	2	3	5	2	0	7.0	13	0	0	0	1
270	14.0	4	6	6	6	6	13.0	14	3	4	2	3
271	12.0	4	5	5	6	4	12.0	12	4	4	2	2

sess: No. of half-hour sessions of face to face contact work with patients.

Si Bal: Sitting balance; St Bal: Standing balance; Amb: Ambulation; Trans: Transfers; Ind Reh: Individual rehabilitation.
PADL: Personal activities of daily living; Kit: Kitchen activities; HV: Home visits; PDFU: Post discharge follow-up; Ind Reh: Individual rehabilitation.

Table 4.3c Duration and type of physiotherapy and occupational therapy input in 48 young stroke patients (aged 75 years or less) managed on general medical wards (Chapters 7,8 & 9).

	Physiotherapy						Occupational Therapy					
Pt No.	Total hrs	Si Bal sess	St Bal sess	Trans sess	Ambul sess	Ind Reh sess	Total hrs	PADL sess	Kit sess	HV sess	PDFU sess	Ind Reh sess
301	17.5	2	1	4	16	12	6.0	8	2	2	0	0
302	5.0	0	0	0	6	4	9.0	12	3	2	0	1
303	27.0	3	10	5	21	15	8.5	16	0	0	0	1
304	6.0	0	4	0	5	3	3.0	5	0	1	0	0
305	22.0	2	2	5	22	13	11.0	13	3	3	0	3
306	7.0	0	2	0	7	5	9.0	14	2	2	0	0
307	17.5	4	8	9	10	4	11.0	21	0	0	0	1
308	29.0	9	2	8	27	12	8.0	9	4	2	0	1
309	23.0	7	8	5	12	16	10.5	15	2	2	0	2
310	18.0	7	8	7	6	8	8.0	12	0	3	0	1
311	22.0	1	12	1	14	16	10.0	14	3	3	0	0
312	12.0	0	4	0	8	12	4.0	5	1	2	0	0
313	23.0	5	9	3	16	13	9.0	14	2	2	0	0
314	8.5	3	4	1	4	5	5.0	6	2	2	0	0
315	22.0	1	5	1	21	16	14.0	16	6	3	0	3
316	14.0	4	9	2	8	5	8.5	14	0	2	0	1
317	7.0	0	4	0	6	4	5.5	10	0	1	0	0
318	6.0	1	3	2	3	3	12.0	14	5	4	0	1
319	34.0	4	19	0	24	21	6.0	7	3	2	0	0
320	5.0	0	4	0	1	5	3.0	2	2	2	0	0
321	22.0	5	10	3	14	12	4.0	5	2	0	0	1
322	19.0	26	12	0	0	0	0.0	0	0	0	0	0
323	16.0	4	16	3	0	9	9.0	15	0	2	0	1
324	11.0	0	0	2	7	13	4.0	4	2	2	0	0
325	23.0	5	17	2	6	16	13.0	17	4	3	0	2
326	21.0	4	8	6	21	3	6.0	8	2	2	0	0
327	6.0	1	1	1	6	3	2.0	2	0	2	0	0
328	24.0	2	5	2	22	17	16.0	21	4	4	0	3
329	13.0	4	9	7	0	6	4.0	6	2	0	0	0
330	18.0	2	12	2	6	14	10.5	16	2	3	0	0
331	4.0	0	2	2	2	2	7.0	10	2	2	0	0
332	15.0	8	13	5	0	4	8.0	11	1	3	0	1
333	2.0	0	0	0	0	4	2.0	2	0	2	0	0
334	27.0	2	17	4	19	12	7.0	8	4	2	0	0
335	21.0	6	8	7	2	19	3.0	6	0	0	0	0
336	7.0	0	2	0	2	10	7.0	9	3	2	0	0
337	21.0	9	7	14	0	12	16.5	27	1	4	0	1
338	9.0	0	2	0	10	6	8.0	11	2	3	0	0
339	6.0	0	0	0	3	9	9.0	12	4	2	0	0
340	17.0	1	6	2	18	7	5.0	6	3	1	0	0
341	6.0	0	0	4	2	6	8.0	10	2	4	0	0
342	18.0	5	10	4	4	13	14.0	20	4	3	0	1
343	21.0	6	7	6	16	7	10.5	21	0	0	0	0
344	4.0	0	1	0	5	2	6.0	7	2	2	0	1
345	22.0	16	6	10	8	4	3.0	6	0	0	0	0
346	16.0	1	5	4	12	10	10.0	15	2	2	0	1
347	5.0	0	2	0	6	2	8.0	10	3	2	0	1
348	19.0	7	6	9	3	13	14.0	25	3	0	0	0

sess: No. of half-hour sessions of face to face contact work with patients.

Si Bal: Sitting balance; St Bal: Standing balance; Amb: Ambulation; Trans: Transfers; Ind Reh: Individual rehabilitation.
PADL: Personal activities of daily living; Kit: Kitchen activities; HV: Home visits; PDFU: Post discharge follow-up; Ind Reh: Individual rehabilitation.

Table 4.3d Duration and type of physiotherapy and occupational therapy input in 53 young stroke patients (aged 75 years or less) managed on the stroke rehabilitation unit (Chapters 7,8 & 9).

	Physiotherapy						Occupational Therapy					
Pt No.	Total hrs	Si Bal sess	St Bal sess	Trans sess	Ambul sess	Ind Reh sess	Total hrs	PADL sess	Kit sess	HV sess	PDFU sess	Ind Reh sess
401	12.0	1	9	0	6	8	5.0	5	1	2	0	2
402	14.0	1	6	3	6	12	12.0	15	3	2	0	4
403	21.0	6	9	1	9	17	8.0	10	2	2	0	2
404	12.0	10	2	2	4	6	6.0	12	0	0	0	0
405	8.5	0	3	1	8	5	11.0	12	3	2	1	4
406	10.0	0	5	2	7	6	8.0	8	2	3	0	3
407	8.0	1	3	0	8	4	5.0	5	1	2	0	2
408	12.0	0	7	0	8	9	10.0	14	3	3	0	3
409	15.0	11	3	2	6	8	8.0	16	0	0	0	0
410	8.0	1	4	0	5	6	7.0	8	2	2	0	2
411	16.0	3	8	0	6	15	10.0	12	3	2	0	3
412	17.0	9	3	0	9	13	15.0	16	4	3	2	5
413	12.0	0	4	2	8	10	10.0	12	3	2	0	3
414	15.0	9	2	3	2	14	3.0	6	0	0	0	0
415	8.0	0	4	0	5	5	11.0	14	2	2	1	3
416	20.0	7	4	2	9	18	12.0	13	4	2	2	3
417	10.0	6	0	0	0	14	0.0	0	0	0	0	0
418	22.0	2	9	2	12	19	5.0	2	3	3	0	2
419	21.0	3	8	0	11	20	5.0	5	2	2	0	1
420	10.0	0	5	1	7	7	4.0	6	1	0	0	1
421	18.0	3	12	0	9	12	11.0	12	3	2	2	3
422	19.0	2	9	2	9	16	5.0	5	2	2	0	1
423	15.0	6	6	1	4	11	8.0	12	2	0	0	2
424	18.0	6	4	3	5	19	15.0	20	4	3	0	3
425	21.0	4	4	4	12	18	7.0	6	2	2	0	4
426	18.0	4	3	4	13	12	11.0	12	2	3	2	3
427	17.0	6	5	4	9	10	9.0	9	2	2	0	3
428	12.0	4	5	3	0	12	3.0	1	1	2	2	0
429	11.0	5	5	1	5	6	2.0	3	1	0	0	0
430	19.5	5	10	0	9	15	5.0	6	2	1	0	1
431	9.0	5	0	1	0	12	4.0	7	0	0	0	1
432	17.0	1	8	2	9	14	3.0	0	2	2	0	2
433	16.0	4	2	3	3	16	14.0	26	2	0	0	0
434	17.0	5	8	0	9	12	5.0	4	3	1	0	2
435	10.5	0	2	1	8	10	13.0	16	3	2	1	4
436	13.0	4	5	3	7	7	6.0	7	2	1	0	2
437	12.0	0	7	1	10	6	6.5	8	2	1	0	2
438	12.0	3	8	1	8	4	14.0	17	3	2	2	4
439	12.0	5	3	4	9	3	3.0	4	1	0	0	1
440	17.5	4	7	1	11	12	7.5	10	2	1	0	2
441	8.0	0	2	0	4	10	13.0	16	3	2	1	4
442	9.0	2	3	4	2	7	6.0	7	2	1	0	2
443	23.5	7	9	0	14	17	8.0	11	3	1	0	3
444	17.0	4	8	0	9	13	12.0	18	1	2	0	3
445	12.0	3	4	4	4	9	12.0	16	3	2	0	3
446	21.0	3	10	3	12	14	7.5	9	2	1	0	3
447	8.0	0	1	0	6	9	2.0	3	0	0	0	1
448	16.0	2	7	4	9	10	15.0	18	4	2	2	4
449	8.0	0	5	2	6	3	6.0	7	2	1	0	2
450	11.0	2	3	4	10	3	2.0	3	0	0	0	1
451	16.5	3	3	2	11	14	13.0	14	3	3	2	4
452	8.0	0	5	0	7	4	3.0	3	0	2	0	1
453	11.0	4	4	3	2	9	11.0	15	2	2	0	3

Si Bal: Sitting balance; St Bal: Standing balance; Amb: Ambulation; Trans: Transfers; Ind Reh: Individual rehabilitation.
PADL: Personal activities of daily living; Kit: Kitchen activities; HV: Home visits; PDFU: Post discharge follow-up; Ind Reh: Individual rehabilitation.

Table 4.4a Serial Barthel index of stroke patients in the middle prognostic group managed on general wards (n=71) between 0-12 weeks after inclusion in the randomised study (Chapter 8).

Pt No	Admn	wk 1	wk 2	wk 3	wk 4	wk 6	wk 8	wk 10	wk 12	Dis
101	4	6	6	7	9	12	14	14	14	14
102	2	2	3	6	6	6	6	6	6	6
104	2	4	4	4	6	6	6	7	7	7
106	5	8	8	12	13	13	16	16	16	16
108	4	4	4	6	7	11	11	14	14	14
110	3	5	7	7	8	11	8	11	11	13
112	5	5	5	5	8	6	14	17	17	17
114	6	8	8	9	9	9	11	11	12	14
116	2	2	2	2	4	5	8	8	8	8
117	6	6	7	7	10	10	12	12	12	16
120	2	5	6	5	3	7	10	10	10	10
122	5	4	6	6	9	12	15	15	16	16
124	2	6	6	8	9	9	10	9	9	11
125	0	0	0	0	0	4	4	4	5	5
127	6	4	5	7	11	14	14	16	17	17
128	2	2	2	4	7	7	7	7	7	9
131	0	0	2	2	2	2	2	2	2	2
132	6	9	9	9	10	11	11	12	12	12
133	4	6	6	6	8	9	9	12	12	14
135	2	4	4	6	6	6	6	6	6	6
137	5	6	7	8	12	12	13	13	14	15
138	2	2	3	6	7	7	9	12	12	12
140	6	10	10	10	11	13	13	14	14	17
142	6	6	6	7	8	12	9	10	12	14
143	1	0	2	2	6	9	13	13	13	13
145	2	4	4	4	4	4	4	4	4	4
146	3	6	8	8	10	11	12	12	12	13
147	2	2	3	3	6	6	11	12	14	12
150	2	4	6	6	6	6	6	6	6	6
151	4	7	8	8	9	12	14	14	14	14
153	5	4	10	10	10	6	8	14	15	15
154	2	2	2	2	2	3	4	7	7	8
156	4	6	6	7	9	12	13	13	13	13
158	4	4	4	8	12	15	16	16	18	16
159	5	8	8	9	9	11	12	12	12	12
162	4	3	4	4	4	4	4	4	4	14
163	5	12	12	12	15	16	16	16	16	16
164	3	3	3	6	7	11	11	12	13	15
165	6	8	8	9	10	12	12	12	12	12
167	5	4	6	6	8	9	11	14	16	17
168	1	0	0	0	2	2	4	4	4	4
170	4	4	4	5	6	7	7	7	10	15
171	3	6	6	6	7	6	7	7	5	7
173	2	2	5	9	10	10	10	10	10	10
301	6	8	9	9	10	11	13	x	17	13
303	0	0	3	2	6	6	8	8	8	8
305	7	10	10	11	14	14	14	16	16	16
308	5	5	5	7	8	12	x	x	12	12
309	0	2	2	4	5	6	9	9	9	9
310	4	4	5	7	10	13	13	x	13	13
311	7	7	7	9	10	12	13	13	13	15
313	2	4	6	7	9	9	10	x	10	10

Table 4.4a contd./

Table 4.4a (contd.) Serial Barthel index of stroke patients in the middle prognostic group managed on general wards (n=71) between 0-12 weeks after inclusion in the randomised study (Chapter 8).

Pt No	Admn	wk 1	wk 2	wk 3	wk 4	wk 6	wk 8	wk 10	wk 12	Dis
315	0	0	0	1	6	9	10	11	11	14
316	6	9	9	10	10	10	13	x	13	13
319	4	8	13	15	17	18	x	x	20	18
321	6	4	4	7	9	9	10	10	10	12
322	2	6	7	10	0	4	4	6	8	10
323	3	2	2	5	6	7	11	x	11	11
325	5	8	8	9	10	11	11	11	11	13
326	0	0	3	3	5	8	8	x	7	8
328	0	2	3	6	7	10	10	11	11	13
329	5	9	3	3	7	11	x	x	11	11
330	0	2	2	3	4	7	7	10	10	12
332	7	4	4	6	7	8	10	x	10	10
334	4	4	5	5	9	9	9	11	11	13
337	2	6	8	8	9	10	10	10	10	10
340	8	11	11	11	11	11	11	x	11	11
342	5	10	12	16	17	18	18	x	18	18
343	0	0	1	3	6	6	5	6	6	8
346	6	6	6	6	8	10	10	x	10	10
348	4	3	3	7	10	12	12	x	12	12

Admn: Barthel index on admission
Dis: Barthel index at discharge
wk: week

Table 4.4b Serial Barthel index of stroke patients in the middle prognostic group managed on the stroke unit (n=75) between 0-12 weeks after inclusion in the randomised study (Chapter 8).

Pt No	Admn	wk 1	wk 2	wk 3	wk 4	wk 6	wk 8	wk 10	wk 12	Dis
202	2	6	8	8	9	x	x	x	9	9
208	4	4	8	9	11	12	12	x	14	12
215	2	4	7	13	13	x	x	x	13	13
216	5	8	10	13	14	16	x	x	18	16
217	4	4	7	12	15	x	x	x	15	15
219	4	6	9	11	11	x	x	x	11	11
221	0	0	0	3	4	4	6	6	6	6
222	6	4	9	12	17	x	x	x	20	17
223	3	7	9	12	14	x	x	x	14	14
224	8	12	14	17	20	x	x	x	20	20
225	6	7	7	11	11	x	x	x	12	12
226	2	0	0	2	3	5	4	6	6	6
228	6	9	11	11	14	18	x	x	18	18
229	4	4	7	7	10	12	12	x	14	12
233	0	4	6	0	0	3	6	x	4	8
234	5	8	12	15	17	x	x	x	17	17
236	2	2	7	11	6	11	13	13	13	13
239	5	7	11	14	17	x	x	x	18	18
240	2	2	5	7	8	11	11	x	11	11
241	6	10	12	15	15	x	x	x	15	15
242	4	4	5	6	7	9	9	x	9	9
243	3	5	7	9	9	10	11	11	11	11
244	5	4	7	11	14	x	x	x	16	16
245	6	8	9	11	13	12	14	15	15	15
246	4	4	7	7	9	10	10	10	10	10
247	6	7	11	13	14	15	17	x	17	17
248	8	9	11	14	17	x	x	x	20	20
249	4	4	6	9	10	12	12	x	12	12
250	2	2	2	3	5	x	x	x	7	7
252	6	9	11	14	17	x	x	x	20	18
253	0	2	6	11	11	4	6	8	8	8
255	7	11	14	16	19	x	x	x	20	19
256	4	4	6	6	9	11	11	x	12	12
257	5	7	11	13	16	x	x	x	17	17
258	4	2	2	3	6	7	7	x	8	8
259	5	9	11	14	16	x	x	x	16	16
260	6	7	9	13	14	16	x	x	16	16
261	4	5	6	3	7	9	11	11	11	11
262	7	6	8	13	15	x	x	x	15	15

Table 4.4b contd./

Table 4.4b (contd.) Serial Barthel index of stroke patients in the middle prognostic group managed on the stroke unit (n=75) between 0-12 weeks after inclusion in the randomised study (Chapter 8).

Pt No	Admn	wk 1	wk 2	wk 3	wk 4	wk 6	wk 8	wk 10	wk 12	Dis
263	3	3	4	4	6	9	10	10	10	10
264	2	5	8	11	13	10	13	13	13	13
265	6	10	13	16	18	x	x	x	18	18
266	8	12	15	16	17	17	19	x	20	19
267	3	5	7	4	9	12	13	x	15	15
268	4	4	4	6	10	x	x	x	10	10
270	5	9	10	10	12	13	13	16	16	16
271	5	5	9	13	17	x	x	x	18	18
401	9	12	15	17	x	x	x	x	17	17
402	7	11	17	19	x	x	x	x	20	19
403	2	5	7	10	11	13	14	x	16	14
408	11	13	15	13	18	x	x	x	18	18
411	3	7	9	11	14	x	x	x	16	16
412	12	12	14	16	18	x	x	x	20	18
414	0	5	9	11	11	x	x	x	11	11
416	2	7	12	13	13	15	15	15	15	15
418	3	3	6	12	14	16	x	x	16	16
419	4	7	11	17	18	x	x	x	20	20
421	3	7	10	15	17	x	x	x	18	17
422	9	13	15	17	x	x	x	x	18	17
424	3	8	5	9	11	14	16	x	16	16
425	4	2	3	6	9	11	11	x	12	12
426	11	11	11	14	19	x	x	x	19	19
427	4	7	14	17	x	x	x	x	18	18
430	7	7	9	11	11	13	14	x	14	14
431	0	4	6	6	x	x	x	x	4	6
432	5	7	12	15	18	x	x	x	18	18
434	4	4	4	9	11	11	13	x	13	13
436	11	9	14	17	19	x	x	x	20	19
438	11	13	17	18	x	x	x	x	17	18
440	3	5	7	11	11	14	16	x	16	16
443	5	5	7	7	9	11	11	x	12	12
444	3	3	3	5	7	7	8	x	9	9
446	5	7	9	11	11	12	12	x	12	12
448	0	9	14	17	18	x	x	x	18	18
451	4	5	8	8	10	11	11	x	11	11

Admn: Barthel index on admission
Dis: Barthel index at discharge
wk: week

Appendix II: Methodology of Orpington Prognostic Score

The Orpington Prognostic Score

The Orpington Prognostic Score (OPS) was developed for use in stroke patients prior to rehabilitation and incorporates measures of motor deficit, proprioception, balance and cognition.

Clinical Features	Score
Motor deficit in arm	
MRC grade 5	0
MRC grade 4	0.4
MRC grade 3	0.8
MRC grade 1-2	1.2
MRC grade 0	1.6
Proprioception (eyes closed)	
locates affected thumb:	
accurately	0
slight difficulty	0.4
finds thumb via arm	0.8
unable to find thumb	1.2
Balance	
walks 10 feet without help	0
maintains standing position	0.4
maintains sitting position	0.8
no sitting balance	1.2
Cognition	
Mental Test Score 10	0
Mental Test Score 8-9	0.4
Mental Test Score 5-7	0.8
Mental Test Score 0-4	1.2

Total score = 1.6 + motor + proprioception + balance + cognition

MRC: Medical Research Council grading for power

The clinical examination on which Orpington Prognostic Score is based is conducted as follows:

A) Motor Function: (To be measured in the upper limb)

Complete paralysis (MRC = 0): When the patient is unable to move the affected limb and no flicker of muscular contraction is visible.

Severe weakness (MRC = 1-2): When there is a flicker when attempting movement or the patient is able to move the affected arm but is unable to lift it to shoulder height and is unable to push against the examiner's hand.

Moderate weakness (MRC = 3): When the patient is able to lift the affected arm to shoulder level but is unable to push against the examiner's hand.

Slight weakness (MRC = 4): When the patient is able to lift the arm to shoulder height and is able to push the examiner's hand but the affected limb is weaker than the unaffected.

No weakness (MRC = 5): There is no difference in the ability of the affected and unaffected limbs to push against the examiner's hand.

B) Proprioception

After explaining and demonstrating the procedure and confirming normal proprioception in the unaffected arm, by the patient touching the nose while their eyes are closed, the examiner lifts the affected arm to eye level. The patient is

then told verbally or by gestures to grasp the thumb of the affected hand with the good hand. The examiner then places a hand over the patient's eyes and raises the patient's affected hand to well above the patient's head. The patient is then asked to grasp the thumb as before.

Severe difficulty: The patient is unable to find his thumb and does not climb up the affected arm in order to locate it.

Moderate difficulty: The patient finds the affected arm and then this leads him to the affected thumb.

Slight difficulty: The patient aims in the right general direction but misses the affected thumb by no more than 3 inches, and is able to locate it within 5 seconds.

No difficulty: The patient is able to locate the affected thumb accurately.

C) Balance

Lying: When the patient is unable to sit up without help, and once sat up is unable to MAINTAIN the sitting position with their legs together and flexed over the side of the bed unsupported.

Sitting: When the patient is able to MAINTAIN the sitting position with their legs together and flexed over the side of the bed without support but is unable to stand.

Standing: When the patient is able to MAINTAIN the standing position without support but cannot walk without human assistance.

Walking: When the patient can walk without human assistance for a distance of about ten feet.

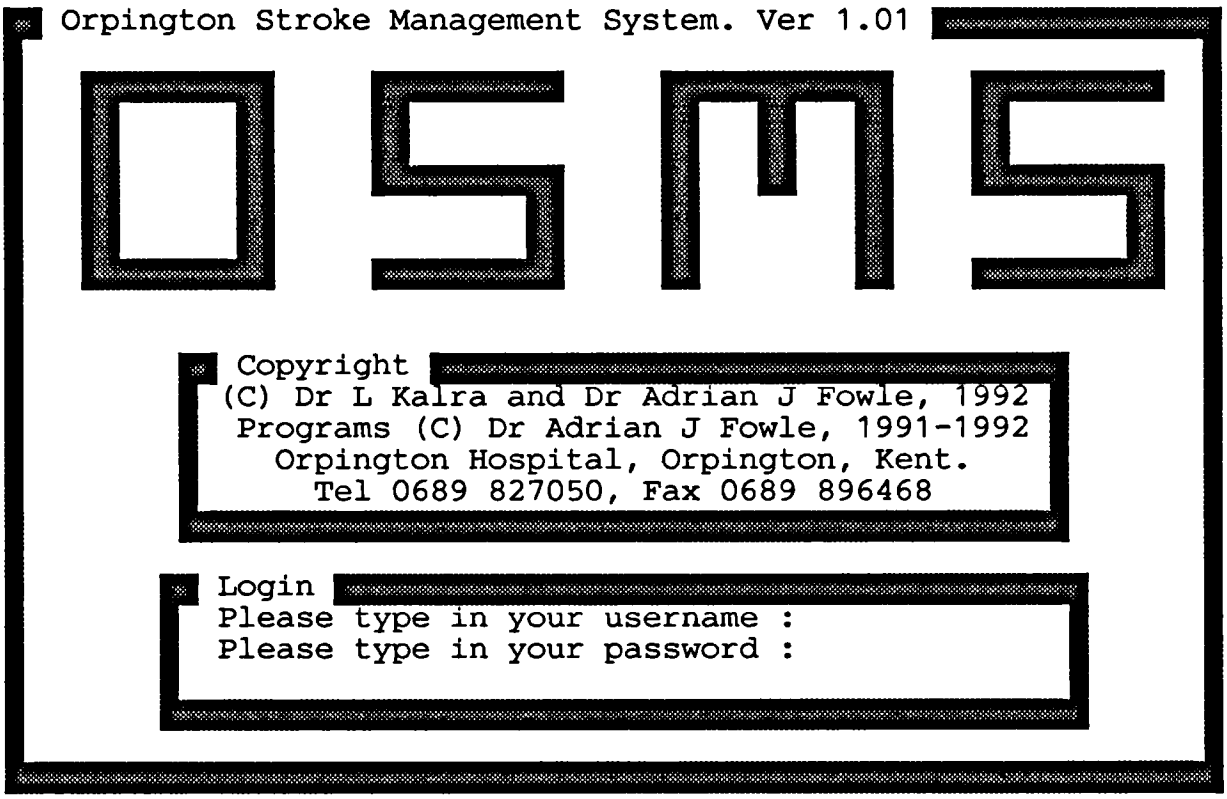
D] Hodkinson's Mental Test score

Score one point for each question answered correctly:

1] Age of the patient	1
2] Time (to nearest hour)	1
3] Address for recall (end of the test):	
42, West Street.	1
4] Name of Hospital	1
5] Year	1
6] Date of birth of patient	1
7] Month	1
8] Years of First World War	1
9] Name of Monarch	1
10] Count backwards from 20-1	1

The test is conducted on the ward with the patient responding verbally to questions asked by the observer. In presence of dysphasias, patients are expected to respond appropriately by speech or signs to spoken or written answers suggested by the observer.

Appendix III: Orpington Stroke Management System.



Basic Registration Details

Title
Surname
Forname Sex

Record_Holder Record_Number

Date_Of_Birth Age

Permanent address - address & other details for patient's usual home.

line 1
2
3

postcode
phone
contact info

area code
residence
detail for "other" residence code

Temporary address - address from which admitted, if not usual address

line 1
2
3
postcode

Details of patient's GP

GP number
name
address
phone
fax
contact info

Details of next of kin

Name
Relationship
Contact Info

Patient details

Surname
Forname
Date_Of_Birth
Record_Number

Details of Admission

Stroke_Date — Age at stroke
Admit_Date — Days after stroke
Refer_Date
Accept_Date
Transfer_Date

Admit_Mode
Ward
Stroke_Cons

Details of death or discharge

	After Stroke	After Transfer
Disposal_Date		
Disposal_Mode		
Disposal_Mode_Other		
Disposal_Res_Code		
Disposal_Area_Code		

Discharge Summary date

Services on discharge

Enter as number of contacts per week.
Use fractions for if less than weekly
eg 0.5 = every other week

Personal care
Home care
Home help
Meals on wheels
Freezer meals
District nurse
Community psyche. nurse
Domicillary OT
Domicillary physio
Day hospital
Stroke club

Anticoagulant clinic
OPD

Stroke_Date

Transfer_Date

Presenting problems

Date of Onset
Date of max deficit
Side of deficit

Time of Onset
Time of max deficit

Headache
Vomiting
Neck stiffness
Hypertension (new)
Fits (new)
Evolving deficit

Glasgow Coma Scale - score for worst defects

Eye Opening
Best motor response
Best verbal response

GCS

Focal deficits when maximal

Higher cerebral dysfunction
Homonymous visual field defect
Disorder of conjugate eye movement
Ipsilat. deficit: 2 or more areas
Pure motor or pure sensory stroke
Ipsilat. deficit: restricted
Cranial N palsy & contralat. deficit
Bilateral motor and/or sensory deficit
Cerebellar & not ipsilat. longtract signs
Ataxic hemiparesis
Medullary or spinal syndromes

Clinical Stroke Subtype:

Sensory symptoms

Sensory loss, right arm
Sensory loss, left arm
Sensory loss, right leg
Sensory loss, left leg

Sensory inattention
Visual inattention

Past medical history

Hypertension
AF
Other arrhythmias
Cardiac Prosthesis
Other heart surgery
Heart failure
TIAs
CVA
Angina
Claudication
MI
Malignancy
Epilepsy
Arthritis
Diabetes Mellitus

Pre-exisiting handicaps [which will affect rehabilitation]

Visual
Hearing
Dementia
Arthritis

Social History

Alcohol units/week.
Tobacco cigs/day.

Drug History - Antihypertensives

Beta blockers
Calcium blockers
ACE inhibitors
Thiazide diuretics
Other antihypertensives

Drug History - Other drugs

If taken at relevent time before stroke

Aspirin
Heparin
Dipyridamole
Warfarin

Observations

BP
- Systolic mm Hg
- Diastolic mm Hg

Heart rate bpm
Pulse rate bpm

Investigations - Blood

Hb g/dl
ESR mm/h
Urea mmol/l
Creatinine micromol/l
Glucose mmol/l

Investigations - ECG

Rate bpm
Rhythm
LVH
LBBB
RBBB
Acute MI
Old MI
Notes on ECG:

Investigations - CXR

Cardiothoracic ratio
Heart failure
Notes on CXR:

Investigations - CT Scan

Was CT performed?
Does CT confirm clinical diagnosis?

Area of lesion

Pathology of lesion

Notes on CT Scan:

Mental Test Score

MTS

Hospital Anxiety & Depression Scale

I feel tense or wound up
I still enjoy things
Something awful
Can laugh
Worrying thoughts
I feel cheerful
I can relax
I feel slow
I have 'butterflies'
Lost intrest in app'rnce
I feel restless
I look forward to things
I feel sudden panic
I enjoy book/radio/TV

Anxiety score Depression score

Frenchay Activities Index

Preparing main meals
Washing up
Washing clothes
Light housework
Heavy housework
Local shopping
Social occasions
Walking outside >15 min
Actively pursuing hobby
Driving car/going on bus
Travel outings/Car rides
Gardening
Household/car maint'nce
Reading books
Gainful work

FAI

MRC Limb Power

Right arm
Right leg
Left arm
Left leg

Orpington Prognostic Score

Proprioception
Balance

Orpington

Motricity Index

Motricity_Pinch
Motricity_Elbow
Motricity_Shoulder
Motricity_Ankle
Motricity_Knee
Motricity_Hip

MotrIDX_Arm MotrIDX_Leg MotrIDX

Functional Ambulation Category

FAC

Right Hemisphere Dysfunction

Level of insight
Left/right orientation
Arrow orientation
Picture identification
Object identification
Draw a clock
Figure/ground
Facial expressions
Crossing out words

Total score

Northwick Park ADL score

Continence		
Mobility (Indoors)		
Stairs (Up)		
Stairs (Down)		
Transfer (Chair/Bed/Chair)		
Using the lavatory		
Use of taps		
Cleaning Teeth		
Bathing/ showering		
Washing self		
Dressing		
Grooming (hair)	(	)
Grooming (shaving)	(	)
Grooming (make up)	(	)
Boiling water		
Preparing hot drink		
Feeding		
Transfer (floor/chair)		
Mobility (outdoors)		
		NPFM

Barthel ADL Scale

Bowels	
Bladder	
Grooming	
Toilet Use	
Feeding	
Transfers	
Walking	
Dressing	
Stairs	
Bathing	
	BADL

Speech & Language assessment - Dysphagia

Liquid
Semi-solid
Solid
Mixed consistency

Dysphagia

Speech and Language Assessment - Dysphasia

French Aphasia Screen (Shortened)

Comprehension (a)
Comprehension (b)

Expression (a)
Expression (b)

Dysphasia

Speech and Language Assessment - Dysarthria

Robertson Dysarthia Profile

To therapist
To carer/relative
To stranger

RDP

Appendix IV: Orpington Stroke Management System Users Survey.

This survey is being undertaken to learn about users' views on the OSMS system in their day-to-day work. This exercise is aimed at improving the system to make it more user-friendly and relevant to stroke management. I would be grateful for your cooperation.

Discipline: Nurse/Physio/OT/Speech Therapy/Doctor/Other

How long have you used OSMS: <1mth 1-3 mths >3mths

How often do you use OSMS: <1/wk 1-2/wk >2/wk

Time spent/session: <15 mins 15-30 mins >30 mins

Do you find the system easy to operate: Yes/No/Sometimes

Are the "on-screen" instructions provided adequate: Yes/No

Have you used the "training mode" provided: Yes/No

Is the "training mode" helpful: Yes/No

Does OSMS increases your work load: Yes/No

Is the information collected useful: Yes/No

Is time spent with OSMS balanced by benefits: Yes/No

Do you think that the OSMS database helps to:

a) improve patient care: Yes/No
b) make multidisciplinary decisions: Yes/No
c) monitor patients progress: Yes/No
d) audit efficacy of the unit: Yes/No
e) describe & maintain quality: Yes/No

Are ward round lists generated by OSMS helpful: Yes /No

Are OSMS discharge summaries more helpful than standard summaries: Yes/No

Is OSMS data suitable for research applications: Yes/No

Can you see any applications of the information collected to your discipline: Yes/No

If yes, what sort of applications:

Appendix V: Publications resulting from the work included in the thesis.

Original research papers:

1) Kalra L, Smith D, Crome P. "Stroke in patients aged over 75 years: Outcome and predictors." Postgraduate Medical Journal 1993;69:33-36.

2) Kalra L, Crome P. "The role of prognostic scores in targeting stroke rehabilitation in elderly patients." The Journal of the American Geriatrics Society 1993;41:396-400.

3) Kalra L, Dale P, Crome P. "Improving stroke rehabilitation: a controlled study." Stroke 1993;24:1462-1467.

4) Kalra L. "Does age affect benefits of stroke unit rehabilitation?" Stroke 1994;25:346-351.

5) Kalra L, Dale P, Crome P. "Stroke rehabilitation units - do elderly stroke patients benefit?" Cerebrovascular Diseases 1994;4:146-151.

6) Kalra L. "Influence of stroke unit rehabilitation on functional recovery from stroke." Stroke 1994;25:821-825.

7) Kalra L, Dale P, Crome P. "Evaluation of a clinical score for prognostic stratification of elderly stroke patients." Age & Ageing 1994 (in press).

8) Kalra L, Fowle AJ. An integrated system for multidisciplinary assessments in stroke rehabilitation. Stroke 1994 (in press).

Refereed abstracts

1) Kalra L, Smith D, Crome P. "Stroke in patients aged over 75 years: Outcome and predictors." Age and Ageing 1992;21 (Suppl 2):P4.

2) Kalra L, Dale P, Randall G, Crome P. "Evaluation of a clinical prognostic scale for elderly stroke patients." Age and Ageing 1993;22 (Suppl 3):P14.

3) Kalra L, Smith D, Crome P. "Stroke in patients aged over 75 years: Outcome and predictors." World Congress of Gerontology, Budapest, July 1993.

4) Kalra L, Dale P, Crome P. "Improving stroke rehabilitation: a controlled study." Journal of the American Geriatrics Society 1993; 41 (Suppl 1):SA18.

5) Kalra L, Dale P, Crome P. "Do stroke units benefit elderly stroke patients?" Age and Ageing 1994;23 (Suppl 1):P5.

6) Kalra L, Fowle AJ. "Integrated clinical workstations: an evaluation on a stroke ward." Age & Ageing 1994; 23 (Suppl 2):P14.

7) Kalra L, Dale P, Crome P. "Does stroke unit rehabilitation hasten functional recovery from stroke?" Age & Ageing 1994;23 (Suppl 2):P8.

8) Kalra L. "An integrated system for multidisciplinary assessments for stroke in elderly people." Aging 1994 (in press)

9) Kalra L, Dale P, Crome P. "A clinical prognostic score for stroke outcome in elderly patients." Journal of the American Geriatrics Society 1994 (in press).

REFERENCES

Abramson AS, Kutner B, Rosenberg AS et al. A therapeutic community in a general hospital: adaptation of a rehabilitation service. Journal of Chronic Diseases 1963;16:179-186.

Adams GF. Prognosis and prospects of stroke. In Cerebrovascular disability and the ageing brain. Edinburgh & London, Churchill-Livingstone, 1974.

Adams RJ, Meador KJ, Sethi KD, Grotta JC, Thompson DS. Graded neurological scale for use in acute hemispheric stroke treatment protocols. Stroke 1987;18:655-659.

Aitken PD, Rodgers H, French JM, Bates D, James OFW. General medical or geriatric unit care for acute stroke? a controlled trial. Age & Ageing 1993; 22 (Suppl2):4-5.

Albers GW, Sherman DG, Gress DR, Paulseth JE, Petersen P. Stroke prevention in non-valvular atrial fibrillation: a review of prospective randomised trials. Annals of Neurology 1991;30:511-518

Alexander JR, Eldon A. Characteristics of elderly people admitted to hospital, part III homes and sheltered housing. Epidemiology and Community Health 1979;33:91-95.

Allen CMC. Predicting recovery after acute stroke. British Journal of Hospital Medicine 1984a;31:428-434

Allen CMC. Predicting the outcome of acute stroke: a prognostic score. Journal of Neurology, Neurosurgery & Psychiatry 1984b;47:475-480.

Altman DG. How large a sample? British Medical Journal 1980;281:1336-1338.

Amery A, Brixko P, Clement D et al. Mortality and morbidity results from the European Working Party on High Blood Pressure in the Elderly Trial. Lancet 1985;1:1349-1354

Amery A, Brixko P, Clement D et al. Efficacy of antihypertensive drug treatment according to age, sex, blood pressure, and previous cardiovascular disease in patients over the age of 60. Lancet 1986;2:589-592

Anderson TP. Studies upto 1980 on stroke rehabilitation outcomes. Stroke 1990;21:1143-1145

Andrews K, Brocklehurst JC, Richards B, Laycock PJ. The rate of recovery from stroke and its measurement. International Rehabilitation Medicine 1981;3:155-161.

Antiplatelet Trialists Collaboration Group. Secondary prevention of vascular disease by prolonged antiplatelet treatment. British Medical Journal 1988; 296:320-331.

Antiplatelet Trialists Collaboration Group. Collaborative overview of randomised trials of antiplatelet therapy I. Prevention of death, myocardial infarction and stroke by prolonged antiplatelet therapy in variuos categories of patients. British Medical Journal 1994;308:81-106.

Applegate WB, Blass JP, Williams TF. Instruments for the functional assessment of older patients. New England Journal of Medicine 1990;322:1207-1214.

Asberg KH, Nydevik I. Early prognosis of stroke outcome by means of Katz Index of activities of daily living. Scandinavian Journal of Rehabilitation Medicine 199;23:187-191.

Asplund K. Haemodilution in acute stroke. Cerebrovascular Diseases 1991 (Suppl 1):129-138.

Bamford J, Sandercock P, Warlow C, Gray M. Why are patients with acute stroke admitted to hospital? British Medical Journal 1986;1:1369-1372

Bamford J, Sandercock P, Dennis M, Warlow C. A prospective study of acute cerebrovascular disease in the community: the Oxfordshire Community Stroke Project: I. Methodology, demography and incident cases of first ever stroke. Journal of Neurology, Neurosurgery and Psychiatry; 1988:51:1373-1380.

Bamford J, Sandercock P, Dennis M, Warlow C. A prospective study of acute cerebrovascular disease in the community: the Oxfordshire Community Stroke Project: II. Incidence, case fatality rates and overall outcome at one year of cerebral infarction, primary intracerebral and subarachnoid haemorrhage. Journal of Neurology, Neurosurgery and Psychiatry; 1990:53:16-22.

Bamford J, Sandercock P, Dennis M, Burn J, Warlow C. Classification and natural history of clincally identifiable subtypes of cerebral infarction. Lancet 1991;337:1521-1526.

Barer DH, Mitchell JRA. Predicting the outcome of acute stroke: Do multivariate models help? Quarterly Journal of Medicine 1989;261:27-39.

Barer DH. Continence after stroke: useful predictor or goal of therapy. Age and Ageing 1989;18:183-191

Barer DH, Nouri F. Measurements of activities of daily living. Clinical Rehabilitation 1990;3:179-187.

Barer D, Main A, Lodwick R. Practicability of early treatment of acute stroke. Group for the Understanding of the effects of the Stroke Syndrome (GUESS). Lancet 1993;339:1540-1541.

Baum H, Goldstein M. Cerebrovascular disease type specific mortality 1968-1977. Stroke 1982;13:810-817.

Benedetti MD, Benedetti M, Stenta G, Costa B, Fiaschi A. Short-term prognosis of stroke in a clinical series of 94 patients. Italian Journal of Neurological Sciences 1993;14:121-127.

Benjamin J. The Northwick Park ADL index. British Journal of Occupational Therapy 1976;39:160-163.

Bishop DS, Epstein NB, Keitner GI, Miller IW, Srinivasan SV. Stroke: morale, family functioning, health status and functional capacity. Archives of Physical Medicine and Rehabilitation 1986;67:84-87.

Blower P, Shaukat A. A stroke unit in a district general hospital: the Greenwich experience. British Medical Journal 1979;2:644-646.

Bonita R, Scragg R, Stewart A, Jackson R, Beaglehole R. Cigarette smoking and risk of premature stroke in men and women. British Medical Journal 1986;293:6-8.

Bonner CD. Stroke units in community hospitals. A "How-to" guide. Geriatrics 1973;28:166-170.

Borhani NO. Stroke surveillance: the concept of stroke team in diagnosis, treatment and prevention. Stroke 1974:5:78-80.

Britton M, De Faire U, Helmers C, et al. Prognostication in acute cerebrovascular disease. Subjective assessment and test of prognostic score. Acta Medica Scandanavica 1980;207:37-42

Brocklehurst JC, Andrews K, Richards B, Laycock PJ. How much physical therapy for patients with stroke? British Medical Journal 1978;i:1307-1310.

Broderick JP. Stroke trends in Rochester, Minnesota, during 1945-1984. Annals of Epidemiology 1993;3:476-479.

Bromley Health Authority Department of Public Health Medicine: Report on the Health of Bromley's Population,1990

Brommels M, Tilvis R, Autio F. Cerebrovascular Disease: declining incidence but increasing hospital utilisation. Scandinavian Journal of Social Medicine 1987;15:153-157.

Brott T, Adams HP, Olinger CP et al., Measurements of acute cerebral infarction: a clinical examination scale. Stroke 1989;20:864-870.

Brown MM, Humphrey PRD. Carotid endarterectomy: recommendations for management of transient ischaemic attack and ischaemic stroke. British Medical Journal 1992;305:1071-1074.

Capildeo R, Clifford-Rose F. The assessment of neurological disability. In: Greenhalgh RM, Clifford-Rose F, eds. Progress in stroke research 1. Tunbridge Wells: Pitman Press,1979:106-116.

Carpenter RR, Reed DE. The outcome of patients with cerebrovascular disease in university and community hospitals. Stroke 1972;3:747-758.

Carstairs V. Resource Consumption and Cost to the Community. In: Stroke, eds Gillingham FJ, Mawdsley C, Williams AE, Churchill Livingstone, New York, 1976:516-528:

Censori B, Camerlingo M, Casto L, Ferraro B, Gazzaniga GC, Cesana B, Mamoli A. Prognostic factors in first-ever stroke in the carotid artery territory seen within 6 hours after onset. Stroke 1993;24:532-535.

Charlton JRH, Velez R. Some international comparisons of mortality amenable to medical intervention. British Medical Journal 1986;292:295-301.

Chiou IL, Burnett CN. Values of activities of daily living: a survey of stroke patients and their home therapists. Archives of Physical Medicine and Rehabilitation 1985;65:901-906.

Cochrane AL. Effectiveness & efficiency: random reflections on Health Services, London, Nuffield Provincial Hospitals Trust,1972.

Colditz GA, Bonita R, Stampfer MJ, et al. Cigarette smoking and risk of stroke in middle-aged women. New England Journal of Medicine 1988;318:937-941

Collen FM, Wade,DT, Bradshaw CM. Mobility after stroke: reliability of measures of impairment and disability. International Disability Studies 1990;12:6-9.

Collen FM, Wade DT, Robb GF, Bradshaw CM. The Rivermead mobility index: a reliability study. International Disability Studies 1991;13:50-54.

Collin C, Wade DT, Davis S, Horne V. The Barthel ADL index: a reliability study. International Disability Studies 1988;10:61-63.

Collin CE, Wade DT. Assessing motor impairment after stroke: a pilot reliability study. Journal of Neurology, Neurosurgery & Psychiatry 1990;53:576-579.

Collins R, Peto R, MacMahon S et al., Blood pressure, stroke and coronary heart disease. Part 2, short-term reductions in blood pressure: overview of randomised drug trials in their epidemiological context. Lancet 1990;335:827-838.

Consensus Conference. Treatment of Stroke. British Medical Journal 1988;297:126-127.

Cooper SW, Olivet JA, Woolsey FM. Establishment and operation of combined intensive care unit for patients with cardiac and cerebrovascular disorders. New York State Journal of Medicine 1972;72:2215-2220.

Cutler JA, Grandits GA, Grimm RH Jr, Thomas HE Jr, Billings JH, Wright NH. Risk factor changes after cessation of intervention in the Multiple Risk Factor Intervention Trial. The MRFIT Research Group. Preventive Medicine 1991;20:183-196.

Daly LE, Bourke GJ, McGilvray J. Interpretation and uses of medical statistics. Fourth Edition. Blackwell, Oxford,1991.

Davis AM, Davis S, Moss N, et al. First steps towards an interdisciplinary approach to rehabilitation. Clinical Rehabilitation 1992;

David RM, Enderby P, Bainton D. Treatment of acquired aphasias: speech therapists and volunteers compared. Journal of Neurology, Neurosurgery & Psychiatry 1982;45:957-961.

Demeurisse G, Demol O, Robaye E. Motor evaluation in vascular hemiplegia. European Neurology 1980;19:382-389.

Dennis M, Warlow CP. Strategy for stroke. British Medical Journal 1991;303:636-638.

Deyo RA. Measuring functional outcomes in therapeutic trials for chronic disease. Controlled Clinical Trials 1984;5:223-240

Dickstein R, Hocherman S, Pillar T, Shaham R. Stroke rehabilitation: three exercise therapy approaches. Physical Therapy 1986;66:1233-1238.

Dlugacz YD, Siegel C, Fischer JD. Receptivity towards uses of a new computer application in medicine. In: Proceedings of the IEEE 6th annual symposium on computer applications in medical care. IEEE Computer Society Publications, Long Beach, California 1982 pp 384-388.

Dobkin BH. Focused stroke rehabilitation programs do not improve outcome. Archives of Neurology 1989;46:701-703.

Donaldson SW, Wagner CC, Gresham GE. A unified ADL evaluation form. Archives of Physical Medicine and Rehabilitation 1973;54:175-179.

Donnan GA, McNeil JJ, Adena MA, Doyle AE, O'Malley HMO, Neill GC. Smoking as a risk factor for cerebral ischaemia. Lancet 1989;ii:643-647.

Dow RS, Dick HL, Crowell FA. Failures and successes in a stroke program. Stroke 174;5:40-47.

Drake WE, Hamilton MJ, Carlsson M, Blumenkrantz J. Acute stroke management and patient outcome: The value of neurovascular care units. Stroke 1973;4:933-945.

Dromerick A, Reding M. Medical and neurological complications during inpatient stroke rehabilitation. Stroke 1994;25:358-361.

Duckworth D. The need for a standard terminology and classification of disablement. In Functional assessment in rehabilitation medicine ed. Granger CV & Gresham GE, Baltimore, Williams & Wilkins,1984:1-13.

Dunbabin DW, Sandercock PAG. Investigation of acute stroke: what is the most efffective strategy. Postgraduate Medical Journal 1991;67:259-270.

Eakin P. Assessments of Activities of Daily Living: a critical review. British Journal of Occupational Therapy 1989;52:11-15.

Ebrahim S, Nouri F, Barer D. Cognitive impairment after stroke. Age & Ageing 1985;14:345-350

Ebrahim S, Nouri F, Barer D. Use of the Nottingham Health Profile with patients after a stroke. Journal of Epidemiology and Community Health 1986;40:166-169.

Ebrahim S. Clinical epidemiology of stroke. Oxford University Press, Oxford, 1990.

Edmans JA, Towle D. Comparison of stroke unit and non-stroke unit in patients on independence in ADL. British Journal of Occupational Therapy 1990;53:415-418

Edmans JA, Lincoln NB. Treatment of visual perceptual deficits after stroke: Single case studies on four patients with right hemiplegia. British Journal of Occupational Therapy 1991; 54 (4):139-144

Enderby PM, Wood VA, Wade DT, Langton-Hewer R. The Frenchay aphasia screening test: a short simple test for aphasia appropriate for non-specialists. International Rehabilitation Medicine 1986;8:166-170.

Enthoven A. Reflections on Management of the National Health Service. Nuffield Provincial Hospitals Trust, London 1985

Erila T, Ilmavirta M. Does an intensive care stroke unit reduce early case fatality rate of ischaemic stroke? Stroke 1990;21 (Suppl 1):153.

European Atrial Fibrillation Trial Study Group. Secondary prevention in non-rheumatic atrial fibrillation after transient ischaemic attack or minor stroke. Lancet 1993;342:1255-1262.

European Carotid Surgery Trialists' Collaborative Group. MRC European Carotid Surgery Trial: interim results for symptomatic patients with severe (70-99%) or with mild (0-29%) carotid stenosis. Lancet 1991;337:1235-1243.

Evans RL, Matlock AL, Bishop DS, Stranahan S, Pederson C. Family intervention after stroke: does counselling or education help? Stroke 1988;19:1243-1249.

Falconer JA, Naughton BJ, Strasser DC, Sinacore JM. Stroke inpatient rehabilitation: a comparison across age groups. Journal of the American Geriatric Society 1994;42:39-44.

Feigenson J, McDowell F, Meese P, McCarthy M, Greenberg S. Factors influencing outcome and length of stay in a stroke rehabilitation unit I: analysis of 248 unscreened patients: medical and functional prognostic indicators. Stroke 1977;8:651-656.

Feigenson JS, McCarthy ML. Guidelines for establishing a stroke rehabilitation unit. New York State Journal of Medicine 1977;34:1430-1434

Feigenson JS, Gitlow HS & Greenberg SD. The disability orientated rehabilitation unit: a major factor influencing stroke outcome. Stroke 1979;10:5-8.

Feinstein AR, Josephy BR, Wells CK. Scientific and clinical problems in indexes of functional disability. Annals of Internal Medicine,1986;105:413-420.

Feldman DJ, Lee PR, Unterecker J, Lloyd K, Rusk HA, Toole A. A comparison of functionally orientated medical care and formal rehabilitation in the management of patients with hemiplegia due to cerebrovascular disease. Journal of Chronic Diseases 1962;15:297-310.

Forbes JF. Cost of Stroke. Scottish Medical Journal 1993;38(Suppl 3):S4-5.

Friedman PJ. Stroke rehabilitation in the elderly: a new patient management system. New Zealand Medical Journal 1990;103:234-236

Gardner MJ, Winter PD, Barker DJP. Atlas of mortality from selected diseases in England & Wales; Chichester:Wiley;1984.

Garraway WM, Akhtar AJ, Prescott RJ, Hockey L. Management of acute stroke in the elderly: Preliminary results of a controlled trial. British Medical Journal 1980;280:1040-1043

Garraway WM, Akhtar AJ, Hockey L, Prescott RJ. Management of acute stroke in the elderly: follow-up of a controlled trial. British Medical Journal 1980;281:827-829

Garraway WM, Whisnant JP, Drury I. The continuing decline in the incidence of stroke. Mayo Clinic Proceedings 1983a;58:520-523

Garraway WM, Whisnant JP, Drury I. The changing pattern of survival following stroke. Stroke 1983b;14:699-703.

Garraway M. Stroke rehabilitation units: concepts evaluation and unresolved issues. Stroke 1985;16:178-181.

Geigy Scientific Tables, Vol 2, 8th edition. edited C. Lentner. Ciba-Geigy, Basle 1982.

Gibbon B. A reassessment of nurses' attitudes towards stroke patients in general medical wards. Journal of Advanced Nursing 1991;16:1336-42.

Gladman JR, Harwood DM, Barer DH. Predicting the outcome of acute stroke: prospective evaluation of five multivariate models and comparison with simple methods. Journal of Neurology, Neurosurgery and Psychiatry 1992;55:347-351.

Gladman JRF, Lincoln NB, Barer DH. A randomised controlled trial of domiciliary and hospital based rehabilitation for stroke patients after discharge from hospital. Journal of Neurology, Neurosurgery & Psychiatry 1993;56:960-966.

Gladman JRF, Lincoln NB. Follow-up of a controlled trial of domiciliary stroke rehabilitation (DOMINO study). Age & Ageing 1994; 23:9-13.

Glantz SA. Computers in clinical medicine: a critique. Computer 1978;18:68-77

Goldie PA, Matyas TA, Spencer KI, McGinley RB. Postural control in standing following stroke: test-retest reliability of some quantitative clinical tests. Physical Therapy 1990;70:234-243.

Granger CV, Sherwood CC, Grre DS. Functional status measures in comprehensive stroke care program. Archives of Physical Medicine and Rehabilitation 1977;58:555-561.

Granger CV. A conceptual model for functional assessment. In Functional assessment in rehabilitation medicine ed. Granger CV & Gresham GE, Baltimore, Williams & Wilkins,1984:14-25.

Granger CV, Hamilton BB, Fiedler RC. Discharge outcome after stroke rehabilitation. Stroke 1992;23:978-982.

Gresham GE, Phillips TF, Wolf PA,McNamara PM,Kannel WB, Dawber TR. Epidemiological profile of long-term stroke disability: the Framingham study. Archives of Physical Medicine and Rehabilitation 1979;60:489-495.

Gresham GE. Stroke outcome research. Stroke 1986;17:358-360.

Grieve DW. Monitoring gait. British Journal of Hospital Medicine 1980;24:198-204

Hachinski V. Stroke rehabilitation. Archives of Neurology 1989;46:703.

Halligan PW, Marshall JC, Wade DT. Visuospatial neglect: underlying factors and test sensitivity. Lancet 1989;ii:908-911.

Hamrin E. Early activation in stroke: does it make a difference? Scandinavian Journal of Rehabilitation Medicine 1982a;14:101-109

Hamrin E. One year after stroke: a followup of an experimental study. Scandinavian Journal of Rehabilitation Medicine 1982b;14:111-116

Hankey GJ. Recent advances in cerebrovascular disease. Reviews in Clinical Gerontology 1992a;2:187-206.

Hankey GJ. Investigation and imaging strategies in acute stroke and transient ischaemic attacks. Hospital Update 1992b;18:107-123

Harper GD, Haigh RA, Potter JF, Castleden CM. Factors delaying admission to hospital after stroke in Leicestershire. Stroke 1992;23:835-838.

Harris AI. Handicapped and Impaired in Great Britain. Part I. Office of Population, Censuses and Surveys. HMSO, London,1971.

Heinemann A, Elliot J, Cichowski K, Betts H. Multivariate analysis of improvement and outcome following stroke rehabilitation. Archives of Neurology 1987;44:1167-1172.

Hier DB, Edelstein G. Deriving clinical prediction rules from stroke outcome research. Stroke 1991;22:1431-1436.

Hinkle JL. Development of an acute stroke unit. Journal of Neuroscience Nursing 1992;24:113-116.

Hodkinson HM. Evaluation of a mental test score for assessment of mental impairment in the elderly. Age and Ageing 1972;1:233-238.

Holden MK, Gill KM, Magliozzi MR, Nathan J, Piehl-Baker L. Clinical gait assessment in the neurologically impaired: reliability and meaningfulness. Physical Therapy 1984;64:35-40

Holden MK, Gill KM, Magliozzi MR. Gait assessment for a neurologically impaired patients. Standards for outcome assessment. Physical Therapy 1986;66:1530-1539.

Hommel M, Memin B, Besson G, Perret J. Hospital admissions and acute stroke units. Cerebrovascular Diseases 1991;1(Suppl 1):50-53.

Horrocks P. The components of a comprehensive district health service for elderly people - A personal view. Age and Ageing 1986;15:321-342

Howard D, Patterson K, Franklin S, Orchard-Lisle, Morton J. Treatment of word retrieval deficits in aphasia. A comparison of two therapy methods. Brain 1985;108:817-829.

Inaba M, Edberg E, Montgomery J, Gillis MK. Effectiveness of functional training, active exercise and resistive exercise for patients with hemiplegia. Physical Therapy 1973;52:28-35.

Indredavik B, Bakke F, Solberg R, et al. Benefit of a stroke unit: A randomised controlled trial. Stroke 1991;22:1026-1031.

Isaacs B, Marks R. Determinants of outcome of stroke rehabilitation. Age & Ageing 1973;2:139-149

Isaacs B. Five years experience of a stroke unit. Health Bulletin 1977;35:93-98.

Isaacs B. Problems and solutions in rehabilitation of stroke patients. Geriatrics 1978;33:87.

Isard PA, Forbes JF. The cost of stroke to the National Health Service. Cerebrovascular Diseases 1992;2:47-90.

Jitapunkul S, Pillay I, Ebrahim S. The Abbreviated Mental Test: Its use and validity. Age & Ageing 1991;20:332-336

Jongbloed L. Prediction of function after stroke : a critical review. Stroke 1986;17:765-766.

Kannel WB, Gordon T. The Framingham study: An epidemiological investigation of cardiovascular disease. US Government Printing Office, Washington DC,1974

Keith RA. Status of measurement in stroke rehabilitation outcomes. Stroke 1990;21(supplII):30-31.

Kelly-Hayes M, Wolf PA, Kannel WB, Sytkowski P, D'Agostino RB, Gresham GE. Factors influencing survival and need for institutionalisation following stroke: The Framingham study. Archives of Physical Medicine and Rehabilitation 1988;69:415-418.

Kelly-Hayes M. Time-intervals, survival and destination: three crucial variables in stroke outcome research. Stroke 1990;21(suppl II):24-26.

Kennedy FB, Pozen TJ, Gabelman EH. Stroke intensive care: an appraisal. American Heart Journal 1970;80:188-196.

Klag MJ, Welton PK, Seidler AJ. Decline in US stroke mortality. Demographic trends and antihypertensive medication. Stroke 1989;20:14-21.

Kurtzke JF. The current neurological burden of illness and injury in the United States. Neurology 1982;32:1207-1214.

Langton-Hewer R, Holbrook M. The Bristol Stroke Unit. Health Trends 1983;15:15-18.

Langton-Hewer R, Wood VA. Availability of computed tomography of the brain in the United Kingdom. British Medical Journal 1989;298:1219-1220.

Langton-Hewer R. Rehabilitation after stroke. Quarterly Journal of Medicine 1990;279:659-674

Langhorne P, Williams BO, Gilchrist W, Howie K. Do stroke units save lives? Lancet 1993;342:395-398

Law M, Letts L. A critical review of scales of Activities of Daily Living. American Journal of Occupational Therapy 1989;43:522-528.

Lees KR. Developments in acute stroke care. Scottish Medical Journal 1992; 38 (Suppl3):S8-9.

Levine SR, Brott TG. Thrombolytic therapy in cerebrovascular disorders. Progress in Cardiovascular Diseases 1992;34:235-262.

Levinson D. Information, computer and clinical practice. Journal of the American Medical Association 1983;249:607-609.

Lincoln NB, Pikersgill MJ, Hankey AI, Hilton CR. An evaluation of operant training and speech therapy in the language rehabilitation of moderate aphasics Behavioural Psychotherapy 1982; 10:162-178.

Lincoln NB, McGuirk E, Mulley GP, Lendrem W, Jone AC, Mitchell JRA. Effectiveness of speech therapy for aphasic stroke patients: a randomised controlled trial. Lancet 1984;i:1197-1200.

Lincoln NB, Pickersgill MJ. The effectiveness of programmed instruction with operant training in the language rehabilitation of severely aphasic patients. Behavioural Psychotherapy 1984; 12:237-248.

Lincoln NB, Jones AC, Mulley JP. Psychological effects of speech therapy. Journal of Psychosomatic Research 1985;29:467-474.

Lincoln NB. Stroke rehabilitation. Current Opinion in Neurology & Neurosurgery 1992;5:677-681.

Lincoln TL. Medical information science: a joint endeavour. Journal of the American Medical Association 1983;249:610-612.

Lind K. A synthesis of studies on stroke rehabilitation. Journal of Chronic Diseases 1982;35:133-149.

Logigian MK, Samuels MA, Falconer J, Zagar R. Clinical exercise trial for stroke

patients. Archives of Physical Medicine and Rehabilitation 1983; 64:364-367.

Lord JP, Hall K. Neuromuscular re-education versus traditional programmes for stroke rehabilitation. Archives of Physical Medicine and Rehabilitation 1986;67:88-91

Macleod J. The nervous system in Clinical Examination, Sixth Edition, Churchill-Livingstone, Edinburgh, 1983.

MacMahon S, Peto R, Cutler J et al., Blood pressure, stroke and coronary heart disease. Part 1, prolonged differences in blood pressure: prospective observational studies corrected for regression dilution bias. Lancet 1990;335:765-774.

Malmgren R, Bamford J, Warlow C, Sandercock P, Slattery J. Projecting the number of patients with first ever strokes and patients newly handicapped by stroke in England and Wales. British Medical Journal 1989;298:656-660.

Marquardsen J. The natural history of acute cerebrovascular disease: a retrospective study of 769 patients. Copenhagen, Munksgaard,1969.

Martin J, Meltzer H, Elliot D. The prevalence of disability among adults. Office of Population Censuses and Surveys, 1988; HMSO, London.

McCann C, Culbertson RA. Comparison of two systems for stroke rehabilitation in a general hospital. Journal of the American Geriatric Society 1976;24:211-216.

McGinnis GE, Seward ML, DeJong G, Osberg JS. Program evaluation of physical medicine and rehabilitation medicine departments using self-report Barthel. Archives of Physical Medicine and Rehabilitation 1986;67:123-125.

Medical Research Council (MRC) Working Party. MRC trial of treatment of hypertension, principle results. British Medical Journal 1985;291:97-104

Millikan CH. Stroke intensive care units. Stroke 1979;10:235-237.

Morris AD, Grosset DG, Squire IB, Lees KR,Bone I, Reid JL. The experiences of an acute stroke unit - implications for multicentre acute stroke trials. Journal of Neurology, Neurosurgery and Psychiatry 1993;56:352-355.

Muir-Gray J. Social and community aspects of ageing. In Principles and Practice of Geriatric Medicine, ed. Pathy MSJ, 1st edition, Wiley, Chichester, 1985:17-55

Newman M. The process of recovery after hemiplegia. Stroke 1972;3:702-710.

Norris JW, Hachinski V. Intensive care management of stroke patients. Stroke 1976;7:573-575.

Norstrom T, Thorslund M. The structure of IADL and ADL measures. Age and Ageing 1991;20:23-28.

North American Symptomatic Carotid Endarterectomy Trial (NASCET). Beneficial effect of carotid endaterectomy in symptomatic patients withhigh-grade carotid stenosis. New England Journal of Medicine 1991; 325:445-453.

Office of Health Economics. Stroke 1988.

Office Population Censuses & Surveys. Occupational mortality decennial supplement 1979-80,1982-83. Series DS, No.6. London HMSO 1986.

Orgogozo JM, Castel JP, Dartigues JF, et al. A stroke unit in Bordeaux: L'Unite de Pathologie Vasculaire Cerebrale. In Advances in Stroke Therapy, Ed. F.Clifford-Rose, New York, Raven Press,1982.

Orgogozo JM. Evaluations of treatment in ischaemic stroke patients. In Clinical trial methodology in stroke. ed. Amery WK, Bousser MG, Cliiford-Rose F, London, Balliere-Tindall,1989:35-53.

Osberg JS, Haley SM, McGinnis GE, DeJong G. Characteristics of cost outliers who did not benefit from stroke rehabilitation. American Journal of Physical Medicine and Rehabilitation 1990;69:117-125

Ottenbacher KJ, Jannell S. The results of clinical trials in stroke rehabilitation research. Archives of Neurology 1993;50:37-44.

OXCHECK Study Group of the Imperial Cancer Research Fund. Prevalence of risk factors for heart disease in OXCHECK trial: implications for screening in primary care. British Medical Journal 1991;302:1057-1060.

OXCHECK Study Group of the Imperial Cancer Research Fund. Effectiveness of health checks conducted by nurses in primary care: results of the OXCHECK study after one year. British Medical Journal 1994;308:308-312.

Oxfordshire Community Stroke Project. Incidence of stroke in Oxfordshire: first year's experience of a community stroke register. British Medical Journal 1983;287:713-717

Panayiotou BN, Fotherby MD, Potter JF, Castleden CM. Eligibility of acute stroke patients for pharmacological therapy. Age and Ageing 1994;23:384-387.

Parfenchuck TA, Parziale JR, Liberman JR,Butcher RP. The evolution of an acute care hospital unit to a DRG exempt rehabilitation unit. A preliminary communication. American Journal of Physical Medicine and Rehabilitation 1990;69:11-15.

Peacock, PB, Riley CHP, Lampton TD, Raffel SS, Walker JS. The Birmingham stroke epidemiology and rehabilitation study. In: Stewart GT,ed. Trends in epidemiology. Springfield, Illinois: Thomas 1972:231-345.

Persson U, Silverberg R, Lindgren B, Norrving B, Jadback G, Johansson B, Puranen BI. Direct costs of stroke for a Swedish population. International Journal of Technology Assessment in Health Care 1990;6:125-137.

Pittner SE, Mance CJ. An evaluation of stroke intensive care:results in a municipal hospital. Stroke 1973;4:737-741.

Prescott RJ, Garraway WM, Akhtar AJ. Predicting functional outcome following acute stroke using a standard clinical examination. Stroke 1982;13:641-647

Qureshi KN, Hodkinson HM. Evaluation of a ten-question mental test in the institutionalised elderly. Age & Ageing 1974;3:152-157

Rapko H, Adaskin E. Computerised hopsitals: an attraction or deterrent to recruitment in nursing? Canadian Journal of Nurse Adminstration 1993;6:19-21.

Reding MJ, McDowell FH. Focused stroke rehabilitation programs improve outcome. Archives of Neurology;1989;700-701.

Rehabilitation Study Group. Report of the Joint Committee for Stroke Facilities II. Stroke 1972;3:375-407.

Reznikoff M, Holland CH, Stroebel CF. Attitudes towards computers among employees of a psychiatric hospital. Mental Hygiene 1967;51:419-425.

Ricci S, Celani MG, LaRosa F, Vitali R, Duca E, Ferraguzzi R, Paolotti M, Seppoloni D, Caputo N, Ciurulla C, et al. SEPIVAC: A community based study of stroke incidence in Umbria, Italy. Journal of Neurology, Neurosurgery & Psychiatry 1991:54:695-698.

Rose G. Strategy for prevention: lessons from cardiovascular disease. British Medical Journal 1981;282:1847-1850.

Rose G, Day S. The population mean predicts the number of deviant individuals. British Medical Journal 1990;301:1031-1034.

Rothrock JF, Hart RG. Antithrombotic therapy in cerebrovascular disease. Annals of Internal Medicine 1991;115:885-895

Royal College of Physicians. Stroke: Towards better management. Royal College of Physicians of London, London, 1989.

Russell IT, Hamilton S, Tweedie V. Models of health care for stroke. Scottish Medical Journal 1993;38:S15-S17.

Sandin KJ, Smith BS. The measure of balance in sitting in stroke rehabilitation prognosis. Stroke 1990;21:82-86.

Sandercock P, Molyneaux A, Warlow C. Value of computed tomography in patients with stroke: Oxfordshire Community Stroke Project. British Medical Journal 1985;290:193-197.

Sandercock P, Willems H. Medical treatment of acute ischaemic stroke. Lancet 1992; 339:537-539.

Scarpa R, Smeltzer SC, Jasion B. Attitudes of nurses towards computerisation: a replication. Computers in Nursing 1992;10:72-80.

Scatton B, Carter C, Benavides J, Giroux C. N-methyl-D-aspartate receptor antagonists: a novel therapeutic perspective for the treatment of ischaemic brain injury. Cerebrovascular Diseases 1991;1:121-135.

Schwartz WB. Medicine and the computer: the promise and the problems of change. New England Journal of Medicine 1970;283:1257-1264.

Seale C, Davies P. Outcome measurement in stroke rehabilitation research. International Disabilities Studies 1986;17:358-360.

Secretary of State for Health. The Health of the Nation: a consultative document for health in England. London, England: HMSO 1991.

Shah S, Vanclay F, Cooper B. Predicting discharge status at commencement of stroke rehabilitation. Stroke 1989;20:766-769

Shah S, Vanclay F, Cooper B. Stroke rehabilitation: Australian patient profile and functional outcome. Journal of Clinical Epidemiology 1991;44:21-28

Shaper AG, Phillips AN, Pocock SJ, Walker M, McFarlane PW. Risk factors for stroke in middle aged British men. British Medical Journal 1991; 302:1111-1115.

Sheikh K, Smith DS, Meade TW, Goldenberg E, Brennan PJ, Kinsella G. Repeatability and validity of a modified activities of daily living (ADL) index in studies on chronic disability. International Rehabilitation Medicine 1979;1:51-58.

Shinton R, Beevers G. Meta-analysis of relation between cigarette smaoking and stroke. British Medical Journal 1989; 298:789-794.

Shinton R, Sagar G. Lifelong exercise and stroke British Medical Journal 1993;307:231-234.

Sivinius J, Pyorala K, Heinonen OP, Salonen JT, Riekkinen P. The significance of intensity of rehabilitation after stroke - a controlled trial. Stroke 1985;16:928-931.

Skilbeck CE, Wade DT, Langton-Hewer R, Wood VA. Recovery after stroke. Journal of Neurology, Neurosurgery and Psychiatry 1983;46:5-8.

Smith DS, Goldenberg E, Ashburn A. Remedial therapy after stroke: a randomised controlled trial. British Medical Journal 1981;282:517-520.

Smith DS. Outcome studies in stroke rehabilitation. The South Australian Stroke Study. Stroke 1990;21(9 Suppl):1156-58.

Smith GT. The economics of hypertension and stroke. American Heart Journal 1990;119:725-728.

Smith ME, Garraway WM, Smith DL, Akhtar AJ. Therapy impact on functional outcome in a controlled trial of stroke rehabilitation. Archives of Physical Medicine and Rehabilitation 1982;63:21-24.

Sorensen PS, Boysen G, Jensen G, Schnohr P. Prevalence of stroke in a district of Copenhagen. Acta Neurologica Scandinavica 1982;66:68-81.

Sotaniemi KA, Phytinen J, Myllyla VV. Correlation of clinical and computed tomographic findings in stroke patients. Stroke 1990;21:1562-1566.

Spence DJ, Donner A. Problems in design of stroke treatment trials. Stroke 1982;13:94-99.

Startsman TS, Robinson RE. The attitudes of medical and paramedical personnel towards computers. Computing and Biomedical Research 1972;5:218-227.

Stephen PJ, Lightbody IM. A comprehensive rehabilitation service produced by integration of existing facilities. Clinical Rehabilitation 1991;5:35-39.

Stern PH, McDOwell F, Miller JM, Robinson M. Effect of facilitation exercise techniques in stroke rehabilitation. Archives of Physical Medicine and Rehabilitation 1970; 51:526-531.

Stevens RS, Ambler NR, Warren MD. A randomised controlled trial of a stroke rehabilitation ward. Age & Ageing 1984;13:65-75

Stone SP. The Mount Vernon Stroke Service: a feasibility study to determine whether it is possible to apply the principles of stroke unit management to patients and their families on general medical wards. Age & Ageing 1987;16:81-88.

Stone SP, Patel P, Greenwood RJ. Selection of acute stroke patients for treatment of visual neglect. Journal of Neurology, Neurosurgery & Psychiatry 1993;56:463-466.

Strand T, Asplund K, Eriksson S, Hagg E, Lithner F, Wester PO. A non-intensive stroke unit reduces disability and the need for long-term hospitalisation. Stroke 1985;16:29-34.

Sultana N. Nurses' attitudes towards computerisation in clinical practice. Journal of Advanced Nursing 1990;15:696-702

Sunderland A, Tinson DJ, Bradley EL, Fletcher D, Langton-Hewer R, Wade DT. Enhanced physical therapy improves recovery of arm function after stroke: a randomised controlled trial. Journal of Neurology, Neurosurgery & Psychiatry 1992;55:530-535.

Taub NA, Wolfe CDA, Richardson E, Burney PGJ. Predicting the disability of first time stroke sufferers at one year. 12-month follow-up of a population based cohort in southeast England. Stroke 1994;25:353-357.

Teach RL, Shortliffe EH. An analysis of physician attitudes regarding computer-based clinical consultation systems. Computing and Biomedical Research 1981;14:542-558.

Teasdale G, Jennett B. Assessment of coma and impaired conciousness. A practical scale. Lancet 1974;2:81-83.

The Stroke Prevention in Atrial Fibrillation Study Group. Preliminary report of The Stroke Prevention in Atrial Fibrillation Study. New England Journal of Medicine 1990;322:863-868.

The Stroke Prevention in Atrial Fibrillation Study Group. The Stroke Prevention in Atrial Fibrillation Study: final results. Circulation 1991;84:527-539.

Tinetti ME, Ginter SF. Identifying mobility dysfunctions in elderly patients: standard neuromuscular examination or direct assessment? Journal of the American Medical Association 1988;259:1190-1193.

Tinson DJ. How do stroke patients spend their day: an observational study of the treatment regime offered to patients in hospital with movement disorders following stroke. International Disability Studies 1989;11:45-49.

Towle D, Lincoln NB, Mayfield LM. Service provision and functional independence in depressed stroke patients and the effects of social work intervention on these. Journal of Neurology, Neurosurgery & Psychiatry 1989;52:519-522.

Underwood MS, More R. The aspirin papers. British Medical Journal 1994;308:91.

US Department of Health, Education and Welfare: Guidelines for stroke care. Eds Johns AL, Hartman EC & Aronson SM. Washington DC. US Government Printing Office,1976.

Von Arbin M, Britton M, De Faire U et al., A study of stroke patients treated in a non-intensive stroke unit or in general medical wards. Acta Medica Scandinavica 1980;208:81-85.

Wade DT. Assessing disability after acute stroke. In Stroke: Epidemiological, Therapeutic and Socioeconomic Aspects. Ed. F. Clifford-Rose, Royal Society of Medicine, London, 1986:101-114

Wade DT. Epidemiologically based needs assessment: Stroke. District Health Authorities: Research Programme, National Health Service Management Executive, London 1992a.

Wade DT. Evaluating outcome in stroke rehabilitation. Scand J Rehab Med 1992b; (suppl 26) 97-104.

Wade DT. Measurement in Neurological Rehabilitation. Oxford University Press, Oxford,1992c.

Wade DT. Stroke: rehabilitation and long-term care. Lancet 1992d;339:791-793.

Wade DT. Is stroke rehabilitation worthwhile? Current Opinions in Neurology and Neurosurgery 1993a;6:78-82.

Wade DT & the Rivermead Speciality Team. Services for people with stroke. Quality in Health Care 1993b;2:263-266.

Wade DT, Collin CE. The Barthel ADL index: A standard measure of physical disability? International Disability Studies 1988; 10:64-67.

Wade DT, Langton Hewer R. Hospital admission for acute stroke: who, for how long and to what effect? Journal of Epidemiology and Community Health 1985a;39:347-352

Wade DT, Langton-Hewer R. Outcome after an acute stroke: urinary incontinence and loss of conciousness compared in 532 patients. Quarterly Journal of Medicine 1985b; 221:347-352.

Wade DT, Langton-Hewer R. Rehabilitation after stroke. In Handbook of Clinical Neurology 11, ed. Toole JF, Amsterdam, Elsevier, 1989:233-254.

Wade DT, Langton-Hewer R, Wood V, Skilbeck C, Ismail H. The hemiplegic arm after stroke: measurement and recovery. Journal of Neurology, Neurosurgery & Psychiatry 1983;46:521-524.

Wade DT, Legh-Smith J, Langton-Hewer R. Social activities after stroke: measurement and natural history using the Frenchay Activities Index. International Rehabilitation Medicine 1985;7:176-181.

Wade DT, Skilbeck CE, Langton Hewer R. Predicting Barthel ADL score at 6 months after an acute stroke. Archives of Physical Medicine and Rehabilitation 1983;64:24-28

Wade DT, Skilbeck CE, Langton-Hewer R, Wood VA. Therapy after stroke: amounts determinants and effects. International Rehabilitation Medicine 1984;6:105-110.

Wade DT, Wood VA, Langton Hewer R. Use of hospital resources by acute stroke patients. Journal of the Royal College of Physicians 1985;19:48-52

Walsh KJ, Barnes MP, McLellan DL. A rehabilitation ward in a district general hospital: first three years experience. British Medical Journal 1988;297:1252-1256.

Warlow C. Secondary prevention of stroke. Lancet 1992;339:724-727.

Weiller C, Chollet F, Friston KJ, Wise RJS, Frankoviak RSJ. Functional reorganisation of brain in recovery from striatocapsular infarction in man. Annals of Neurology 1992;31:463-472.

Whiteside MF, McCullough J, Whiteside JA. Helping hospital educators and clinical nurse specialists learn to use and develop computer assisted instruction. Journal of Continuing Education in Nursing 1990;21:113-117.

Whiting SE, Lincoln NB, Bhavnani G, Cockburn J. The Rivermead Perceptual Assessment Battery. NFER-Nelson, Windsor.

Wolfe CDA, Burney PGJ. Is stroke mortality on the decline in England? American Journal of Epidemiology 1992;136:558-565.

Wolfe CDA, Taub NA, Woodrow EJ, Burney PGJ. Assessment of scales for disability and handicap for stroke patients. Stroke 1991;22:1242-1244.

Wolf PA, D'Agostino RB, Kannel WB, Bonita R, Belanger AJ. Cigarette smoking as a risk factor for stroke : the Framingham study. Journal of American Medical Association 1988; 259:1025-1029.

Wood-Daupinee S, Shapiro S, Bass E, Fletcher C, Georges P, Hensby V, Mendelsohn B. A randomised trial of team care following stroke. Stroke 1984;15:864-872.

World Health Organisation: Cerebrovascular diseases: prevention, treatment and rehabilitation. World Health Organisation Technical Report Series, No.469. World Health organisation, Geneva,1971.

World Health Organisation. The international classification of impairments, disabilities and handicaps. Geneva, World Health Organisation, 1980.

World Health Organisation Scientific Group Report: The uses of epidemiology in the study of the elderly. Technical Report Series No.706 World Health Organisation, Geneva,1984.

World Health Organisation Special Report: Stroke 1989: recommendations on stroke prevention, diagnosis, and therapy. Stroke 1989;20:1407-1431.

Young A. Assessment for rehabilitation after stroke. Annals of Academic Medicine of Singapore 1988;17:267-274

Young DW. What makes doctors use computers? Journal of the Royal Society of Medicine 1984;77:663-667.

Young DW, Chapman AD, Poile C. Consultant views on computer systems. British Journal of Health Care Computing 1990;7:63-67.

Young DW. Clinical computing systems: their slow introduction. Postgraduate Medical Journal 1990;66:333-335.

Young J, Forster A: The Bradford community stroke trial: 8 week results. Clinical Rehabilitation 1991;5:283-292.

Young JB, Forster A: The Bradford community stroke trial: results at six months. British Medical Journal 1992;304:1085-1089.

Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatrica Scandinavica 1983;67:361-370.

Zoltan-Ford E, Chapanis A. What do professional persons think about computers. In: Anderson, JG and Jay SJ (eds), Use and impact of computers in clinical medicine, Springer-Verlag, New York,1987, pp.51-67.